References

[1] P. Mulvaney, "Nanoscience vs Nanotechnology□ Defining the Field," vol. 9, ed: ACS Publications, 2015, pp. 2215-2217.

[2] M. Karkare, *Nanotechnology: fundamentals and applications*. IK International Pvt Ltd, 2013.

[3] J. Tarafdar and R. Raliya, *Nanotechnology*. Scientific Publishers, 2012.

[4] M. T. Bohr, "Nanotechnology goals and challenges for electronic applications," *IEEE Transactions on Nanotechnology,* vol. 1, no. 1, pp. 56-62, 2002.

[5] E. Serrano, G. Rus, and J. Garcia-Martinez, "Nanotechnology for sustainable energy," *Renewable and Sustainable Energy Reviews,* vol. 13, no. 9, pp. 2373-2384, 2009.

[6] A. K. Hussein, "Applications of nanotechnology in renewable energies—A comprehensive overview and understanding," *Renewable and Sustainable Energy Reviews,* vol. 42, pp. 460-476, 2015.

[7] A. Surendiran, S. Sandhiya, S. Pradhan, and C. Adithan, "Novel applications of nanotechnology in medicine," *Indian Journal of Medical Research,* vol. 130, no. 6, pp. 689-701, 2009.

[8] G. A. Silva, "Introduction to nanotechnology and its applications to medicine," *Surgical neurology,* vol. 61, no. 3, pp. 216-220, 2004.

[9] J. Weiss, P. Takhistov, and D. J. McClements, "Functional materials in food nanotechnology," *Journal of food science,* vol. 71, no. 9, pp. R107-R116, 2006.

[10] L. Dai, "Carbon nanotechnology: recent developments in chemistry, physics, materials science and device applications," 2006.

[11] E. Pomerantseva, F. Bonaccorso, X. Feng, Y. Cui, and Y. Gogotsi, "Energy storage: The future enabled by nanomaterials," *Science,* vol. 366, no. 6468, p. eaan8285, 2019.

[12] M. O. Emeje, I. C. Obidike, E. I. Akpabio, and S. I. Ofoefule, "Nanotechnology in drug delivery," *Recent advances in novel drug carrier systems,* vol. 1, no. 4, pp. 69-106, 2012.

[13] W. Jiang, B. Y. Kim, J. T. Rutka, and W. C. Chan, "Advances and challenges of nanotechnology-based drug delivery systems," *Expert opinion on drug delivery,* vol. 4, no. 6, pp. 621-633, 2007.

[14] M. Rafique, M. B. Tahir, M. S. Rafique, and M. Hamza, "History and fundamentals of nanoscience and nanotechnology," in *Nanotechnology and photocatalysis for environmental applications*: Elsevier, 2020, pp. 1-25.

[15] B. Zhang, *Physical fundamentals of nanomaterials*. William Andrew, 2018.

[16] S. Cuenot, C. Frétigny, S. Demoustier-Champagne, and B. Nysten, "Surface tension effect on the mechanical properties of nanomaterials measured by atomic force microscopy," *Physical Review B,* vol. 69, no. 16, p. 165410, 2004.

[17] D. Vollath, F. D. Fischer, and D. Holec, "Surface energy of nanoparticles–influence of particle size and structure," *Beilstein journal of nanotechnology,* vol. 9, no. 1, pp. 2265-2276, 2018.

[18] W. Luo, W. Hu, and S. Xiao, "Size effect on the thermodynamic properties of silver nanoparticles," *The Journal of Physical Chemistry C,* vol. 112, no. 7, pp. 2359-2369, 2008.

[19] A. B. Asha and R. Narain, "Nanomaterials properties," in *Polymer science and nanotechnology*: Elsevier, 2020, pp. 343-359.

[20] R. Koole, E. Groeneveld, D. Vanmaekelbergh, A. Meijerink, and C. de Mello Donegá, "Size effects on semiconductor nanoparticles," *Nanoparticles: Workhorses of Nanoscience,* pp. 13-51, 2014.

[21] A. Fernando, K. D. M. Weerawardene, N. V. Karimova, and C. M. Aikens, "Quantum mechanical studies of large metal, metal oxide, and metal chalcogenide nanoparticles and clusters," *Chemical reviews,* vol. 115, no. 12, pp. 6112-6216, 2015.

[22] K. Wang *et al.*, "Advances in energy-efficient plasmonic electrochromic smart windows based on metal oxide nanocrystals," *Advanced Energy and Sustainability Research,* vol. 2, no. 12, p. 2100117, 2021.

[23] C. G. Granqvist, "Electrochromics for smart windows: Oxide-based thin films and devices," *Thin solid films,* vol. 564, pp. 1-38, 2014.

[24] T. Zhai *et al.*, "A comprehensive review of one-dimensional metal-oxide nanostructure photodetectors," *Sensors,* vol. 9, no. 8, pp. 6504-6529, 2009.

[25] W. Ouyang, F. Teng, J. H. He, and X. Fang, "Enhancing the photoelectric performance of photodetectors based on metal oxide semiconductors by charge-carrier engineering," *Advanced Functional Materials,* vol. 29, no. 9, p. 1807672, 2019.

[26] K. McNamara and S. A. Tofail, "Nanoparticles in biomedical applications," *Advances in Physics: X,* vol. 2, no. 1, pp. 54-88, 2017.

[27] M. P. Nikolova and M. S. Chavali, "Metal oxide nanoparticles as biomedical materials," *Biomimetics,* vol. 5, no. 2, p. 27, 2020.

[28] P. C. Nagajyothi, S. V. Prabhakar Vattikuti, K. C. Devarayapalli, K. Yoo, J. Shim, and T. V. M. Sreekanth, "Green synthesis: photocatalytic degradation of textile dyes using metal and metal oxide nanoparticles-latest trends and advancements," *Critical Reviews in Environmental Science and Technology,* vol. 50, no. 24, pp. 2617-2723, 2020.

[29] M. Faraday, "X. The Bakerian Lecture.—Experimental relations of gold (and other metals) to light," *Philosophical transactions of the Royal Society of London,* no. 147, pp. 145-181, 1857.

[30] W. Hergert and T. Wriedt, *The Mie theory: basics and applications*. Springer, 2012.

[31] T. Wriedt, "Mie theory: a review," *The Mie theory: Basics and applications,* pp. 53-71, 2012.

[32] J. M. George, A. Antony, and B. Mathew, "Metal oxide nanoparticles in electrochemical sensing and biosensing: a review," *Microchimica Acta,* vol. 185, pp. 1-26, 2018.

[33] Z. Zhang, J. Liu, J. Gu, L. Su, and L. Cheng, "An overview of metal oxide materials as electrocatalysts and supports for polymer electrolyte fuel cells," *Energy & Environmental Science,* vol. 7, no. 8, pp. 2535-2558, 2014.

[34] N. Jung, D. Y. Chung, J. Ryu, S. J. Yoo, and Y.-E. Sung, "Pt-based nanoarchitecture and catalyst design for fuel cell applications," *Nano today,* vol. 9, no. 4, pp. 433-456, 2014.

[35] V. Mazumder, Y. Lee, and S. Sun, "Recent development of active nanoparticle catalysts for fuel cell reactions," *Advanced Functional Materials,* vol. 20, no. 8, pp. 1224-1231, 2010.

[36] A. Biswas, I. S. Bayer, A. S. Biris, T. Wang, E. Dervishi, and F. Faupel, "Advances in top–down and bottom–up surface nanofabrication: Techniques, applications & future prospects," *Advances in colloid and interface science,* vol. 170, no. 1-2, pp. 2-27, 2012.

[37] W. K. Choi *et al.*, "A combined top-down and bottom-up approach for precise placement of metal nanoparticles on silicon," *small,* vol. 4, no. 3, pp. 330-333, 2008.

[38] N. Abid *et al.*, "Synthesis of nanomaterials using various top-down and bottom-up approaches, influencing factors, advantages, and disadvantages: A review," *Advances in Colloid and Interface Science,* vol. 300, p. 102597, 2022.

[39] V. Arole and S. Munde, "Fabrication of nanomaterials by top-down and bottom-up approaches-an overview," *J. Mater. Sci,* vol. 1, pp. 89-93, 2014.

[40] S. Iravani, H. Korbekandi, S. V. Mirmohammadi, and B. Zolfaghari, "Synthesis of silver nanoparticles: chemical, physical and biological methods," *Research in pharmaceutical sciences,* vol. 9, no. 6, pp. 385-406, 2014.

[41] K. B. Narayanan and N. Sakthivel, "Biological synthesis of metal nanoparticles by microbes," *Advances in colloid and interface science,* vol. 156, no. 1-2, pp. 1-13, 2010.

[42] I. Ijaz, E. Gilani, A. Nazir, and A. Bukhari, "Detail review on chemical, physical and green synthesis, classification, characterizations and applications of nanoparticles," *Green chemistry letters and reviews,* vol. 13, no. 3, pp. 223-245, 2020.

[43] J. Kimling, M. Maier, B. Okenve, V. Kotaidis, H. Ballot, and A. Plech, "Turkevich method for gold nanoparticle synthesis revisited," *The Journal of Physical Chemistry B,* vol. 110, no. 32, pp. 15700-15707, 2006.

[44] M. Wuithschick *et al.*, "Turkevich in new robes: key questions answered for the most common gold nanoparticle synthesis," *ACS nano,* vol. 9, no. 7, pp. 7052-7071, 2015.

[45] B. Pinho, K. Zhang, R. L. Hoye, and L. Torrente-Murciano, "Importance of Monitoring the Synthesis of Light-Interacting Nanoparticles–A Review on In Situ, Ex Situ, and Online Time-Resolved Studies," *Advanced Optical Materials,* vol. 10, no. 14, p. 2200524, 2022.

[46] S. K. Ghosh and T. Pal, "Interparticle coupling effect on the surface plasmon resonance of gold nanoparticles: from theory to applications," *Chemical reviews,* vol. 107, no. 11, pp. 4797-4862, 2007.

[47] M. A. García, "Surface plasmons in metallic nanoparticles: fundamentals and applications," *Journal of Physics D: Applied Physics,* vol. 44, no. 28, p. 283001, 2011.

[48] H. S. Sehmi, W. Langbein, and E. A. Muljarov, "Optimizing the Drude-Lorentz model for material permittivity: Method, program, and examples for gold, silver, and copper," *Physical Review B,* vol. 95, no. 11, p. 115444, 2017.

[49] D. Bohm and D. Pines, "A collective description of electron interactions. I. Magnetic interactions," *Physical Review,* vol. 82, no. 5, p. 625, 1951.

[50] Y. Wang, E. Plummer, and K. Kempa, "Foundations of plasmonics," *Advances in Physics,* vol. 60, no. 5, pp. 799-898, 2011.

[51] C. F. Bohren and D. R. Huffman, *Absorption and scattering of light by small particles*. John Wiley & Sons, 2008.

[52] A. Rider, K. Ostrikov, and S. Furman, "Plasmas meet plasmonics: Everything old is new again," *The European Physical Journal D,* vol. 66, pp. 1-19, 2012.

[53] K. A. Willets and R. P. Van Duyne, "Localized surface plasmon resonance spectroscopy and sensing," *Annu. Rev. Phys. Chem.,* vol. 58, no. 1, pp. 267-297, 2007.

[54] S. Peiris, J. McMurtrie, and H.-Y. Zhu, "Metal nanoparticle photocatalysts: emerging processes for green organic synthesis," *Catalysis Science & Technology,* vol. 6, no. 2, pp. 320-338, 2016.

[55] M. L. Brongersma, N. J. Halas, and P. Nordlander, "Plasmon-induced hot carrier science and technology," *Nature nanotechnology,* vol. 10, no. 1, pp. 25-34, 2015.

[56] J. Hofmann and W. Steinmann, "Plasma resonance in the photoemission of silver," *physica status solidi (b),* vol. 30, no. 1, pp. K53-K56, 1968.

[57] J. Sipe and J. Becher, "Surface-plasmon-assisted photoemission," *Journal of the Optical Society of America,* vol. 71, no. 10, pp. 1286-1288, 1981.

[58] C. F. Bohren, "How can a particle absorb more than the light incident on it?," *American Journal of Physics,* vol. 51, no. 4, pp. 323-327, 1983.

[59] S. Oldenburg, R. Averitt, S. Westcott, and N. Halas, "Nanoengineering of optical resonances," *Chemical Physics Letters,* vol. 288, no. 2-4, pp. 243-247, 1998.

[60] M. Moskovits, "Surface-enhanced spectroscopy," *Reviews of modern physics,* vol. 57, no. 3, p. 783, 1985.

[61] J. I. Gersten and A. Nitzan, "Photophysics and photochemistry near surfaces and small particles," *Surface Science,* vol. 158, no. 1-3, pp. 165-189, 1985.

[62] X. Li, D. Xiao, and Z. Zhang, "Landau damping of quantum plasmons in metal nanostructures," *New Journal of Physics,* vol. 15, no. 2, p. 023011, 2013.

[63] A. Manjavacas, J. G. Liu, V. Kulkarni, and P. Nordlander, "Plasmon-induced hot carriers in metallic nanoparticles," *ACS nano,* vol. 8, no. 8, pp. 7630-7638, 2014.

[64] K. Watanabe, D. Menzel, N. Nilius, and H.-J. Freund, "Photochemistry on metal nanoparticles," *Chemical reviews,* vol. 106, no. 10, pp. 4301-4320, 2006.

[65] M. Lisowski, P. Loukakos, U. Bovensiepen, J. Stähler, C. Gahl, and M. Wolf, "Ultra-fast dynamics of electron thermalization, cooling and transport effects in Ru (001)," *Applied Physics A,* vol. 78, pp. 165-176, 2004.

[66] X.-C. Ma, Y. Dai, L. Yu, and B.-B. Huang, "Energy transfer in plasmonic photocatalytic composites," *Light: Science & Applications,* vol. 5, no. 2, pp. e16017-e16017, 2016.

[67] C. Burda, X. Chen, R. Narayanan, and M. A. El-Sayed, "Chemistry and properties of nanocrystals of different shapes," *Chemical reviews,* vol. 105, no. 4, pp. 1025-1102, 2005.

[68] J. Lehmann, M. Merschdorf, W. Pfeiffer, A. Thon, S. Voll, and G. Gerber, "Surface plasmon dynamics in silver nanoparticles studied by femtosecond time-resolved photoemission," *Physical review letters,* vol. 85, no. 14, p. 2921, 2000.

[69] H. Hövel, S. Fritz, A. Hilger, U. Kreibig, and M. Vollmer, "Width of cluster plasmon resonances: bulk dielectric functions and chemical interface damping," *Physical Review B,* vol. 48, no. 24, p. 18178, 1993.

[70] M. Valenti *et al.*, "Hot carrier generation and extraction of plasmonic alloy nanoparticles," *ACS photonics,* vol. 4, no. 5, pp. 1146-1152, 2017.

[71] M. Bernardi, J. Mustafa, J. B. Neaton, and S. G. Louie, "Theory and computation of hot carriers generated by surface plasmon polaritons in noble metals," *Nature communications,* vol. 6, no. 1, p. 7044, 2015.

[72] C. Clavero, "Plasmon-induced hot-electron generation at nanoparticle/metal-oxide interfaces for photovoltaic and photocatalytic devices," *Nature Photonics,* vol. 8, no. 2, pp. 95-103, 2014.

[73] S. Linic, P. Christopher, and D. B. Ingram, "Plasmonic-metal nanostructures for efficient conversion of solar to chemical energy," *Nature materials,* vol. 10, no. 12, pp. 911-921, 2011.

[74] C. Sönnichsen *et al.*, "Drastic reduction of plasmon damping in gold nanorods," *Physical review letters,* vol. 88, no. 7, p. 077402, 2002.

[75] T. P. White and K. R. Catchpole, "Plasmon-enhanced internal photoemission for photovoltaics: theoretical efficiency limits," *Applied Physics Letters,* vol. 101, no. 7, 2012.

[76] L. Wang, M. Hasanzadeh Kafshgari, and M. Meunier, "Optical properties and applications of plasmonic-metal nanoparticles," *Advanced Functional Materials,* vol. 30, no. 51, p. 2005400, 2020.

[77] S. T. Kochuveedu, Y. H. Jang, and D. H. Kim, "A study on the mechanism for the interaction of light with noble metal-metal oxide semiconductor nanostructures for various photophysical applications," *Chemical Society Reviews,* vol. 42, no. 21, pp. 8467-8493, 2013.

[78] G. Xu *et al.*, "Plasmonic graphene transparent conductors," *Advanced Materials,* vol. 24, no. 10, pp. OP71-OP76, 2012.

[79] S. Ezendam *et al.*, "Hybrid plasmonic nanomaterials for hydrogen generation and carbon dioxide reduction," *ACS Energy Letters,* vol. 7, no. 2, pp. 778-815, 2022.

[80] L. Song, J. Chen, B. B. Xu, and Y. Huang, "Flexible plasmonic biosensors for healthcare monitoring: Progress and prospects," *ACS nano,* vol. 15, no. 12, pp. 18822-18847, 2021.

[81] J. A. Huang and L. B. Luo, "Low-dimensional plasmonic photodetectors: recent progress and future opportunities," *Advanced Optical Materials,* vol. 6, no. 8, p. 1701282, 2018.

[82] X. Shan *et al.*, "Plasmonic optoelectronic memristor enabling fully light-modulated synaptic plasticity for neuromorphic vision," *Advanced Science,* vol. 9, no. 6, p. 2104632, 2022.

[83] F. Enrichi, A. Quandt, and G. C. Righini, "Plasmonic enhanced solar cells: Summary of possible strategies and recent results," *Renewable and sustainable energy reviews,* vol. 82, pp. 2433-2439, 2018.

[84] S. Jana *et al.*, "Halloysite nanotubes with immobilized silver nanoparticles for anti-bacterial application," *Colloids and Surfaces B: Biointerfaces,* vol. 151, pp. 249-254, 2017.

[85] K. Khurana and N. Jaggi, "Localized surface plasmonic properties of Au and Ag nanoparticles for sensors: a review," *Plasmonics,* vol. 16, no. 4, pp. 981-999, 2021.

[86] D. E. Mustafa, T. Yang, Z. Xuan, S. Chen, H. Tu, and A. Zhang, "Surface plasmon coupling effect of gold nanoparticles with different shape and size on conventional surface plasmon resonance signal," *Plasmonics,* vol. 5, pp. 221-231, 2010.

[87] S. Kundu, "A new route for the formation of Au nanowires and application of shape-selective Au nanoparticles in SERS studies," *Journal of Materials Chemistry C,* vol. 1, no. 4, pp. 831-842, 2013.

[88] H. Yuan *et al.*, "Shape and SPR evolution of thorny gold nanoparticles promoted by silver ions," *Chemistry of materials,* vol. 19, no. 7, pp. 1592-1600, 2007.

[89] K.-S. Lee and M. A. El-Sayed, "Gold and silver nanoparticles in sensing and imaging: sensitivity of plasmon response to size, shape, and metal composition," *The journal of physical chemistry B,* vol. 110, no. 39, pp. 19220-19225, 2006.

[90] J. Jana, M. Ganguly, and T. Pal, "Enlightening surface plasmon resonance effect of metal nanoparticles for practical spectroscopic application," *RSC advances,* vol. 6, no. 89, pp. 86174-86211, 2016.

[91] Y. Y. Cai, Y. C. Choi, and C. R. Kagan, "Chemical and Physical Properties of Photonic Noble-Metal Nanomaterials," *Advanced Materials,* vol. 35, no. 34, p. 2108104, 2023.

[92] M. B. Cortie and A. M. McDonagh, "Synthesis and optical properties of hybrid and alloy plasmonic nanoparticles," *Chemical reviews,* vol. 111, no. 6, pp. 3713-3735, 2011.

[93] J. Z. Zhang and C. Noguez, "Plasmonic optical properties and applications of metal nanostructures," *Plasmonics,* vol. 3, pp. 127-150, 2008.

[94] J. Lim and S. A. Majetich, "Composite magnetic–plasmonic nanoparticles for biomedicine: Manipulation and imaging," *Nano Today,* vol. 8, no. 1, pp. 98-113, 2013.

[95] S. Linic, P. Christopher, H. Xin, and A. Marimuthu, "Catalytic and photocatalytic transformations on metal nanoparticles with targeted geometric and plasmonic properties," *Accounts of chemical research,* vol. 46, no. 8, pp. 1890-1899, 2013.

[96] S. M. Morton, D. W. Silverstein, and L. Jensen, "Theoretical studies of plasmonics using electronic structure methods," *Chemical reviews,* vol. 111, no. 6, pp. 3962-3994, 2011.

[97] D. J. de Aberasturi, A. B. Serrano-Montes, and L. M. Liz-Marzán, "Modern applications of plasmonic nanoparticles: from energy to health," *Advanced Optical Materials,* vol. 3, no. 5, pp. 602-617, 2015.

[98] H. Matsui *et al.*, "Infrared plasmonic metamaterials based on transparent nanoparticle films of In2O3: Sn for solar-thermal shielding applications," *ACS Applied Materials & Interfaces,* vol. 14, no. 43, pp. 49313-49325, 2022.

[99] E. S. Arinze, B. Qiu, G. Nyirjesy, and S. M. Thon, "Plasmonic nanoparticle enhancement of solution-processed solar cells: practical limits and opportunities," *Acs Photonics,* vol. 3, no. 2, pp. 158-173, 2016.

[100] W. Wang *et al.*, "Advances in emerging photonic memristive and memristive-like devices," *Advanced Science,* vol. 9, no. 28, p. 2105577, 2022.

[101] P. Berini, "Surface plasmon photodetectors and their applications," *Laser & Photonics Reviews,* vol. 8, no. 2, pp. 197-220, 2014.

[102] R. T. Hill, "Plasmonic biosensors," *Wiley Interdisciplinary Reviews: Nanomedicine and Nanobiotechnology,* vol. 7, no. 2, pp. 152-168, 2015.

[103] A. Loiseau, V. Asila, G. Boitel-Aullen, M. Lam, M. Salmain, and S. Boujday, "Silver-based plasmonic nanoparticles for and their use in biosensing," *Biosensors,* vol. 9, no. 2, p. 78, 2019.

[104] I. Urries *et al.*, "Magneto-plasmonic nanoparticles as theranostic platforms for magnetic resonance imaging, drug delivery and NIR hyperthermia applications," *Nanoscale,* vol. 6, no. 15, pp. 9230-9240, 2014.

[105] R. Abbasi, G. Shineh, M. Mobaraki, S. Doughty, and L. Tayebi, "Structural parameters of nanoparticles affecting their toxicity for biomedical applications: a review," *Journal of Nanoparticle Research,* vol. 25, no. 3, p. 43, 2023.

[106] S. Hazra, S. V. Singh, S. Dahiya, P. K. Aich, and B. N. Pal, "Solution-processed Ag-TiO2 nanostructure-based Schottky junction thin films for narrowband hot-electron photodetectors," *ACS Applied Nano Materials,* vol. 6, no. 16, pp. 15119-15127, 2023.

[107] P. Maity, S. V. Singh, S. Biring, B. N. Pal, and A. K. Ghosh, "Selective near-infrared (NIR) photodetectors fabricated with colloidal CdS: Co quantum dots," *Journal of Materials Chemistry C,* vol. 7, no. 25, pp. 7725-7733, 2019.

[108] X. Zheng and L. Zhang, "Photonic nanostructures for solar energy conversion," *Energy & Environmental Science,* vol. 9, no. 8, pp. 2511-2532, 2016.

[109] W. Ye, R. Long, H. Huang, and Y. Xiong, "Plasmonic nanostructures in solar energy conversion," *Journal of Materials Chemistry C,* vol. 5, no. 5, pp. 1008-1021, 2017.

[110] C.-H. Chou and F.-C. Chen, "Plasmonic nanostructures for light trapping in organic photovoltaic devices," *Nanoscale,* vol. 6, no. 15, pp. 8444-8458, 2014.

[111] K. ElKhamisy, H. Abdelhamid, E.-S. M. El-Rabaie, and N. Abdel-Salam, "A comprehensive survey of silicon thin-film solar cell: challenges and novel trends," *Plasmonics,* vol. 19, no. 1, pp. 1-20, 2024.

[112] L. Huang *et al.*, "Temperature-Gradient Solution Deposition Amends Unfavorable Band Structure of Sb2 (S, Se) 3 Film for Highly Efficient Solar Cells," *Angewandte Chemie,* vol. 136, no. 36, p. e202406512, 2024.

[113] A. G. Waketola, N. A. Tegegne, and F. G. Hone, "Recent Progress in Silver and Gold Nanoparticle-Based Plasmonic Organic Solar Cells," *Plasmonics,* pp. 1-36, 2024.

[114] Y. Ding *et al.*, "Metal nanowire-based transparent electrode for flexible and stretchable optoelectronic devices," *Chemical Society Reviews,* 2024.

[115] W. Song, Q. Ye, Z. Chen, J. Ge, L. Xie, and Z. Ge, "Advances in stretchable organic photovoltaics: flexible transparent electrodes and deformable active layer design," *Advanced Materials,* vol. 36, no. 37, p. 2311170, 2024.

[116] C. Yuan *et al.*, "Stable indium tin oxide with high mobility," *ACS Applied Materials & Interfaces,* vol. 14, no. 44, pp. 49937-49944, 2022.

[117] J. Shi, J. Zhang, L. Yang, M. Qu, D. C. Qi, and K. H. Zhang, "Wide bandgap oxide semiconductors: from materials physics to optoelectronic devices," *Advanced materials,* vol. 33, no. 50, p. 2006230, 2021.

[118] A. Kumar and C. Zhou, "The race to replace tin-doped indium oxide: which material will win?," *ACS nano,* vol. 4, no. 1, pp. 11-14, 2010.

[119] K. Ellmer, "Past achievements and future challenges in the development of optically transparent electrodes," *Nature Photonics,* vol. 6, no. 12, pp. 809-817, 2012.

[120] B. Joshi, E. Samuel, S. An, S. Kim, A. L. Yarin, and S. S. Yoon, "Review of indium-free, transparent and flexible metallic fibers for wearable electronics," *Chemical Engineering Journal,* vol. 475, p. 146189, 2023.

[121] S. De, P. J. King, P. E. Lyons, U. Khan, and J. N. Coleman, "Size effects and the problem with percolation in nanostructured transparent conductors," *ACS nano,* vol. 4, no. 12, pp. 7064-7072, 2010.

[122] S. Schubert, J. Meiss, L. Müller-Meskamp, and K. Leo, "Improvement of transparent metal top electrodes for organic solar cells by introducing a high surface energy seed layer," *Advanced Energy Materials,* vol. 3, no. 4, pp. 438-443, 2013.

[123] M. R. Azani, A. Hassanpour, and T. Torres, "Benefits, problems, and solutions of silver nanowire transparent conductive electrodes in indium tin oxide (ITO)-free flexible solar cells," *Advanced Energy Materials,* vol. 10, no. 48, p. 2002536, 2020.

[124] K. Kim, K. Hong, B. Koo, I. Lee, and J.-L. Lee, "Transparency controllable silver-based electrode for flexible optoelectronics," *Applied Physics Letters,* vol. 102, no. 8, 2013.

[125] M. Rabizadeh, M. H. Ehsani, and M. M. Shahidi, "ZnO/metal/ZnO (metal= Ag, Pt, Au) films for energy-saving in windows application," *Scientific Reports,* vol. 12, no. 1, p. 15575, 2022.

[126] J. Zheng, S. Bao, and P. Jin, "TiO2 (R)/VO2 (M)/TiO2 (A) multilayer film as smart window: Combination of energy-saving, antifogging and self-cleaning functions," *Nano Energy,* vol. 11, pp. 136-145, 2015.

[127] J. Y. Mao, L. Zhou, X. Zhu, Y. Zhou, and S. T. Han, "Photonic memristor for future computing: a perspective," *Advanced Optical Materials,* vol. 7, no. 22, p. 1900766, 2019.

[128] Z. Shen *et al.*, "Emerging optical in-memory computing sensor synapses based on low-dimensional nanomaterials for neuromorphic networks," *Advanced Intelligent Systems,* vol. 4, no. 9, p. 2100236, 2022.

[129] P. A. Mosier-Boss, "Review of SERS substrates for chemical sensing," *Nanomaterials,* vol. 7, no. 6, p. 142, 2017.

[130] U. Dinish, F. C. Yaw, A. Agarwal, and M. Olivo, "Development of highly reproducible nanogap SERS substrates: Comparative performance analysis and its application for glucose sensing," *Biosensors and Bioelectronics,* vol. 26, no. 5, pp. 1987-1992, 2011.

[131] C. Dincer *et al.*, "Disposable sensors in diagnostics, food, and environmental monitoring," *Advanced materials,* vol. 31, no. 30, p. 1806739, 2019.

[132] F. Fung, H.-S. Wang, and S. Menon, "Food safety in the 21st century," *Biomedical journal,* vol. 41, no. 2, pp. 88-95, 2018.

[133] E. C. Alocilja and S. M. Radke, "Market analysis of biosensors for food safety," *Biosensors and Bioelectronics,* vol. 18, no. 5-6, pp. 841-846, 2003.

[134] M. Hoseinnejad, S. M. Jafari, and I. Katouzian, "Inorganic and metal nanoparticles and their antimicrobial activity in food packaging applications," *Critical reviews in microbiology,* vol. 44, no. 2, pp. 161-181, 2018.

[135] A. Yakoubi and C. E. B. Dhafer, "Advanced plasmonic nanoparticle-based techniques for the prevention, detection, and treatment of current COVID-19," *Plasmonics,* vol. 18, no. 1, pp. 311-347, 2023.

[136] F. Paladini and M. Pollini, "Antimicrobial silver nanoparticles for wound healing application: progress and future trends," *Materials,* vol. 12, no. 16, p. 2540, 2019.

[137] M. Moritz and M. Geszke-Moritz, "The newest achievements in synthesis, immobilization and practical applications of antibacterial nanoparticles," *Chemical Engineering Journal,* vol. 228, pp. 596-613, 2013.

[138] S. V. Singh, A. Sharma, S. Biring, and B. N. Pal, "Solution processed Cu2S/TiO2 heterojunction for visible-near infrared photodetector," *Thin Solid Films,* vol. 710, p. 138275, 2020.

[139] N. Pal, A. Sharma, V. Acharya, N. K. Chourasia, S. Biring, and B. N. Pal, "Gate interface engineering for subvolt metal oxide transistor fabrication by using ion-conducting dielectric with Mn2O3 gate interface," *ACS Applied Electronic Materials,* vol. 2, no. 1, pp. 25-34, 2019.

[140] S. V. Singh, M. P. Kumar, S. Anantharaj, B. Mukherjee, S. Kundu, and B. N. Pal, "Direct evidence of an efficient plasmon-induced hot-electron transfer at an in situ grown Ag/TiO2 interface for highly enhanced solar H2 generation," *ACS Applied Energy Materials,* vol. 3, no. 2, pp. 1821-1830, 2020.

[141] S. Habashyani, A. Özmen, S. Aydogan, and M. Yilmaz, "An examination of correlation between characteristic and device performance of ZnO films as a function of La content," *Vacuum,* vol. 157, pp. 497-507, 2018.

[142] M. Yilmaz, A. Kocyigit, S. Aydogan, U. Incekara, A. Tursucu, and H. Kacus, "Light-sensing behaviors of organic/n-Si bio-hybrid photodiodes based on malachite green (MG) organic dye," *Journal of Materials Science: Materials in Electronics,* vol. 31, pp. 21548-21556, 2020.

[143] Ş. Aydoğan, M. L. Grilli, M. Yilmaz, Z. Çaldiran, and H. Kaçuş, "A facile growth of spray based ZnO films and device performance investigation for Schottky diodes: Determination of interface state density distribution," *Journal of Alloys and Compounds,* vol. 708, pp. 55-66, 2017.

[144] R. Sundararaman, P. Narang, A. S. Jermyn, W. A. Goddard III, and H. A. Atwater, "Theoretical predictions for hot-carrier generation from surface plasmon decay," *Nature communications,* vol. 5, no. 1, p. 5788, 2014.

[145] L. Amirav and M. Wächtler, "Nano Schottky?," vol. 22, ed: ACS Publications, 2022, pp. 9783-9785.

[146] J. A. Lee *et al.*, "Schottky nanocontact of one-dimensional semiconductor nanostructures probed by using conductive atomic force microscopy," *Nanotechnology,* vol. 27, no. 42, p. 425711, 2016.

[147] C. F. Tan *et al.*, "Inverse stellation of CuAu-ZnO multimetallic-semiconductor nanostartube for plasmon-enhanced photocatalysis," *ACS nano,* vol. 12, no. 5, pp. 4512-4520, 2018.

[148] P. Zhang, T. Wang, and J. Gong, "Mechanistic understanding of the plasmonic enhancement for solar water splitting," *Advanced Materials,* vol. 27, no. 36, pp. 5328-5342, 2015.

[149] D. Thrithamarassery Gangadharan, Z. Xu, Y. Liu, R. Izquierdo, and D. Ma, "Recent advancements in plasmon-enhanced promising third-generation solar cells," *Nanophotonics,* vol. 6, no. 1, pp. 153-175, 2017.

[150] W. Li and J. G. Valentine, "Harvesting the loss: surface plasmon-based hot electron photodetection," *Nanophotonics,* vol. 6, no. 1, pp. 177-191, 2017.

[151] I. Goykhman *et al.*, "On-chip integrated, silicon–graphene plasmonic Schottky photodetector with high responsivity and avalanche photogain," *Nano letters,* vol. 16, no. 5, pp. 3005-3013, 2016.

[152] J. E. Lee, S. Bera, Y. S. Choi, and W. I. Lee, "Size-dependent plasmonic effects of M and M@ SiO2 (M= Au or Ag) deposited on TiO2 in photocatalytic oxidation reactions," *Applied Catalysis B: Environmental,* vol. 214, pp. 15-22, 2017.

[153] Y.-H. Qiu *et al.*, "Size-dependent plasmon relaxation dynamics and saturable absorption in gold nanorods," *Journal of Physics D: Applied Physics,* vol. 49, no. 18, p. 185107, 2016.

[154] M. W. Knight, H. Sobhani, P. Nordlander, and N. J. Halas, "Photodetection with active optical antennas," *Science,* vol. 332, no. 6030, pp. 702-704, 2011.

[155] X. Ding, Y. Zhao, H. Xiao, and L. Qiao, "Engineering Schottky-to-Ohmic contact transition for 2D metal–semiconductor junctions," *Applied Physics Letters,* vol. 118, no. 9, 2021.

[156] Y. Park, J. Choi, M. Kang, H. Lee, H. Ihee, and J. Y. Park, "Relaxation dynamics of enhanced hot-electron flow on perovskite-coupled plasmonic silver schottky nanodiodes," *The Journal of Physical Chemistry C,* vol. 125, no. 4, pp. 2575-2582, 2021.

[157] B. Liu *et al.*, "Schottky junction made from a nanoporous Au and TiO2 film for plasmonic photodetectors," *ACS Applied Nano Materials,* vol. 6, no. 6, pp. 4619-4625, 2023.

[158] A. Pescaglini *et al.*, "Hot-electron injection in Au nanorod–ZnO nanowire hybrid device for near-infrared photodetection," *Nano letters,* vol. 14, no. 11, pp. 6202-6209, 2014.

[159] Z. Qi *et al.*, "Au nanoparticle-decorated silicon pyramids for plasmon-enhanced hot electron near-infrared photodetection," *Nanotechnology,* vol. 28, no. 27, p. 275202, 2017.

[160] L. V. Besteiro, X.-T. Kong, Z. Wang, G. Hartland, and A. O. Govorov, "Understanding hot-electron generation and plasmon relaxation in metal nanocrystals: quantum and classical mechanisms," *Acs Photonics,* vol. 4, no. 11, pp. 2759-2781, 2017.

[161] Q. Guo, C. Zhou, Z. Ma, and X. Yang, "Fundamentals of TiO2 photocatalysis: concepts, mechanisms, and challenges," *Advanced Materials,* vol. 31, no. 50, p. 1901997, 2019.

[162] A. J. Frank, N. Kopidakis, and J. Van De Lagemaat, "Electrons in nanostructured TiO2 solar cells: transport, recombination and photovoltaic properties," *Coordination Chemistry Reviews,* vol. 248, no. 13-14, pp. 1165-1179, 2004.

[163] J. Zou, Q. Zhang, K. Huang, and N. Marzari, "Ultraviolet photodetectors based on anodic TiO2 nanotube arrays," *The Journal of Physical Chemistry C,* vol. 114, no. 24, pp. 10725-10729, 2010.

[164] A. Furube, L. Du, K. Hara, R. Katoh, and M. Tachiya, "Ultrafast plasmon-induced electron transfer from gold nanodots into TiO2 nanoparticles," *Journal of the American Chemical Society,* vol. 129, no. 48, pp. 14852-14853, 2007.

[165] X. D. Gao *et al.*, "Porous Ag/TiO2-Schottky-diode based plasmonic hot-electron photodetector with high detectivity and fast response," *Nanophotonics,* vol. 8, no. 7, pp. 1247-1254, 2019.

[166] P. Joshna, A. Hazra, K. N. Chappanda, P. K. Pattnaik, and S. Kundu, "Fast response of UV photodetector based on Ag nanoparticles embedded uniform TiO2 nanotubes array," *Semiconductor Science and Technology,* vol. 35, no. 1, p. 015001, 2019.

[167] H. Ferhati, F. Djeffal, and N. Martin, "Highly improved responsivity of self-powered UV–Visible photodetector based on TiO2/Ag/TiO2 multilayer deposited by GLAD technique: Effects of oriented columns and nano-sculptured surface," *Applied Surface Science,* vol. 529, p. 147069, 2020.

[168] T. Yan, S. Cai, Z. Hu, Z. Li, and X. Fang, "Ultrafast speed, dark current suppression, and self-powered enhancement in TiO2-based ultraviolet photodetectors by organic layers and Ag nanowires regulation," *The Journal of Physical Chemistry Letters,* vol. 12, no. 40, pp. 9912-9918, 2021.

[169] H. Tang *et al.*, "Plasmonic hot electrons for sensing, photodetection, and solar energy applications: A perspective," *The Journal of Chemical Physics,* vol. 152, no. 22, 2020.

[170] H. Chalabi, D. Schoen, and M. L. Brongersma, "Hot-electron photodetection with a plasmonic nanostripe antenna," *Nano letters,* vol. 14, no. 3, pp. 1374-1380, 2014.

[171] G. Tagliabue *et al.*, "Quantifying the role of surface plasmon excitation and hot carrier transport in plasmonic devices," *Nature communications,* vol. 9, no. 1, p. 3394, 2018.

[172] L. Wang *et al.*, "Efficient ultraviolet photodetectors based on TiO 2 nanotube arrays with tailored structures," *RSC Advances,* vol. 5, no. 65, pp. 52388-52394, 2015.

[173] K.-T. Lin, H.-L. Chen, Y.-S. Lai, and C.-C. Yu, "Silicon-based broadband antenna for high responsivity and polarization-insensitive photodetection at telecommunication wavelengths," *Nature communications,* vol. 5, no. 1, p. 3288, 2014.

[174] T. Matsui *et al.*, "Highly stable plasmon induced hot hole transfer into silicon via a SrTiO3 passivation interface," *Advanced Functional Materials,* vol. 28, no. 17, p. 1705829, 2018.

[175] P. Wan *et al.*, "Flexible transparent films based on nanocomposite networks of polyaniline and carbon nanotubes for high-performance gas sensing," *Small,* vol. 11, no. 40, pp. 5409-5415, 2015.

[176] T. Gao *et al.*, "Hierarchical graphene/metal grid structures for stable, flexible transparent conductors," *Acs Nano,* vol. 9, no. 5, pp. 5440-5446, 2015.

[177] Y. Zhu, Y. Deng, P. Yi, L. Peng, X. Lai, and Z. Lin, "Flexible transparent electrodes based on silver nanowires: material synthesis, fabrication, performance, and applications," *Advanced Materials Technologies,* vol. 4, no. 10, p. 1900413, 2019.

[178] M. Lagrange, D. Langley, G. Giusti, C. Jiménez, Y. Bréchet, and D. Bellet, "Optimization of silver nanowire-based transparent electrodes: effects of density, size and thermal annealing," *Nanoscale,* vol. 7, no. 41, pp. 17410-17423, 2015.

[179] F. Sun *et al.*, "An autonomously ultrafast self-healing, highly colourless, tear-resistant and compliant elastomer tailored for transparent electromagnetic interference shielding films integrated in flexible and optical electronics," *Materials Horizons,* vol. 8, no. 12, pp. 3356-3367, 2021.

[180] R. Zhu *et al.*, "Fused silver nanowires with metal oxide nanoparticles and organic polymers for highly transparent conductors," *ACS nano,* vol. 5, no. 12, pp. 9877-9882, 2011.

[181] C. F. Guo and Z. Ren, "Flexible transparent conductors based on metal nanowire networks," *Materials Today,* vol. 18, no. 3, pp. 143-154, 2015.

[182] S. Vedraine, A. El Hajj, P. Torchio, and B. Lucas, "Optimized ITO-free tri-layer electrode for organic solar cells," *Organic Electronics,* vol. 14, no. 4, pp. 1122-1129, 2013.

[183] X. Wang *et al.*, "Assembly of silver nanowires and PEDOT: PSS with hydrocellulose toward highly flexible, transparent and conductivity-stable conductors," *Chemical Engineering Journal,* vol. 392, p. 123644, 2020.

[184] J. H. Im, K.-T. Kang, S. H. Lee, J. Y. Hwang, H. Kang, and K. H. Cho, "Bulk-like Al/Ag bilayer film due to suppression of surface plasmon resonance for high transparent organic light emitting diodes," *Organic Electronics,* vol. 33, pp. 116-120, 2016.

[185] H. Lu, D. Zhang, J. Cheng, J. Liu, J. Mao, and W. C. Choy, "Locally welded silver nano-network transparent electrodes with high operational stability by a simple alcohol-based chemical approach," *Advanced Functional Materials,* vol. 25, no. 27, pp. 4211-4218, 2015.

[186] W. Cui, F. Chen, Y. Li, X. Su, and B. Sun, "Status and perspectives of transparent conductive oxide films for silicon heterojunction solar cells," *Materials Today Nano,* vol. 22, p. 100329, 2023.

[187] R. Chakraborty *et al.*, "Fabrication of non-volatile memory transistor by charge compensation of interfacial ionic polarization of a ferroelectric gate dielectric," *Applied Materials Today,* vol. 33, p. 101862, 2023.

[188] T. Lee, E. Choi, J.-O. Park, and D. Bang, "Tunable and highly accessible plasmonic gap nanostructures on flexible film as a high-performance surface-enhanced Raman scattering sensor," *Materials Today Nano,* vol. 23, p. 100370, 2023.

[189] L. Ferrari *et al.*, "Design and analysis of blue InGaN/GaN plasmonic LED for high-speed, high-efficiency optical communications," *ACS Photonics,* vol. 5, no. 9, pp. 3557-3564, 2018.

[190] T. Echtermeyer *et al.*, "Strong plasmonic enhancement of photovoltage in graphene," *Nature communications,* vol. 2, no. 1, p. 458, 2011.

[191] H.-Y. Hou *et al.*, "Boosted radiative energy transfer of plasmonic electrodes enables flexible organic photovoltaics with efficiency over 18%," *Chemical Engineering Journal,* vol. 450, p. 138181, 2022.

[192] Y. H. Jang, Y. J. Jang, S. Kim, L. N. Quan, K. Chung, and D. H. Kim, "Plasmonic solar cells: from rational design to mechanism overview," *Chemical reviews,* vol. 116, no. 24, pp. 14982-15034, 2016.

[193] J. Ma and S. Gao, "Plasmon-induced electron–hole separation at the Ag/TiO2 (110) interface," *ACS nano,* vol. 13, no. 12, pp. 13658-13667, 2019.

[194] C. Pang *et al.*, "Ultrafast electron transfer dynamics in Ag/TiO2 nanocomposite for tailoring of optical nonlinearity," *Applied Surface Science,* vol. 539, p. 148258, 2021.

[195] L. B. Luo *et al.*, "The effect of plasmonic nanoparticles on the optoelectronic characteristics of CdTe nanowires," *Small,* vol. 10, no. 13, pp. 2645-2652, 2014.

[196] J. Song *et al.*, "Highly efficient plasmon induced hot-electron transfer at Ag/TiO2 interface," *ACS Photonics,* vol. 8, no. 5, pp. 1497-1504, 2021.

[197] C. Ng *et al.*, "Hot carrier extraction with plasmonic broadband absorbers," *Acs Nano,* vol. 10, no. 4, pp. 4704-4711, 2016.

[198] F. P. García de Arquer, A. Mihi, and G. Konstantatos, "Large-area plasmonic-crystal–hot-electron-based photodetectors," *ACS photonics,* vol. 2, no. 7, pp. 950-957, 2015.

[199] A. Sobhani *et al.*, "Narrowband photodetection in the near-infrared with a plasmon-induced hot electron device," *Nature communications,* vol. 4, no. 1, p. 1643, 2013.

[200] X. Yu, P. Duxbury, G. Jeffers, and M. Dubson, "Coalescence and percolation in thin metal films," *Physical Review B,* vol. 44, no. 23, p. 13163, 1991.

[201] D. Kim, A. L. Giermann, and C. V. Thompson, "Solid-state dewetting of patterned thin films," *Applied Physics Letters,* vol. 95, no. 25, 2009.

[202] H. Galinski, T. Ryll, P. Elser, J. Rupp, A. Bieberle-Hütter, and L. Gauckler, "Agglomeration of Pt thin films on dielectric substrates," *Physical Review B—Condensed Matter and Materials Physics,* vol. 82, no. 23, p. 235415, 2010.

[203] J. W. Essam, "Percolation theory," *Reports on progress in physics,* vol. 43, no. 7, p. 833, 1980.

[204] S. Chu and A. Majumdar, "Opportunities and challenges for a sustainable energy future," *nature,* vol. 488, no. 7411, pp. 294-303, 2012.

[205] K. R. Abbasi, M. Shahbaz, J. Zhang, M. Irfan, and R. Alvarado, "Analyze the environmental sustainability factors of China: The role of fossil fuel energy and renewable energy," *Renewable Energy,* vol. 187, pp. 390-402, 2022.

[206] M. T. Kartal, "The role of consumption of energy, fossil sources, nuclear energy, and renewable energy on environmental degradation in top-five carbon producing countries," *Renewable Energy,* vol. 184, pp. 871-880, 2022.

[207] N. Kabalina, M. Costa, W. Yang, and A. Martin, "Impact of a reduction in heating, cooling and electricity loads on the performance of a polygeneration district heating and cooling system based on waste gasification," *Energy,* vol. 151, pp. 594-604, 2018.

[208] K. Zhu, M. Victoria, G. B. Andresen, and M. Greiner, "Impact of climatic, technical and economic uncertainties on the optimal design of a coupled fossil-free electricity, heating and cooling system in Europe," *Applied Energy,* vol. 262, p. 114500, 2020.

[209] S. D. Rezaei, S. Shannigrahi, and S. Ramakrishna, "A review of conventional, advanced, and smart glazing technologies and materials for improving indoor environment," *Solar Energy Materials and Solar Cells,* vol. 159, pp. 26-51, 2017.

[210] S. K. Kang, D. H. Ho, C. H. Lee, H. S. Lim, and J. H. Cho, "Actively operable thermoresponsive smart windows for reducing energy consumption," *ACS Applied Materials & Interfaces,* vol. 12, no. 30, pp. 33838-33845, 2020.

[211] Y. Niu *et al.*, "Energy saving and energy generation smart window with active control and antifreezing functions," *Advanced Science,* vol. 9, no. 6, p. 2105184, 2022.

[212] J. Zhou *et al.*, "VO2 thermochromic smart window for energy savings and generation," *Scientific reports,* vol. 3, no. 1, p. 3029, 2013.

[213] M. Kamalisarvestani, R. Saidur, S. Mekhilef, and F. Javadi, "Performance, materials and coating technologies of thermochromic thin films on smart windows," *Renewable and Sustainable Energy Reviews,* vol. 26, pp. 353-364, 2013.

[214] Y. Ke *et al.*, "Two-dimensional SiO2/VO2 photonic crystals with statically visible and dynamically infrared modulated for smart window deployment," *ACS applied materials & interfaces,* vol. 8, no. 48, pp. 33112-33120, 2016.

[215] S.-W. Oh, S.-M. Nam, S.-H. Kim, T.-H. Yoon, and W. S. Kim, "Self-regulation of infrared using a liquid crystal mixture doped with push–pull azobenzene for energy-saving smart windows," *ACS Applied Materials & Interfaces,* vol. 13, no. 4, pp. 5028-5033, 2021.

[216] H. Khandelwal, A. P. Schenning, and M. G. Debije, "Infrared regulating smart window based on organic materials," *Advanced Energy Materials,* vol. 7, no. 14, p. 1602209, 2017.

[217] S. Nundy, A. Mesloub, B. M. Alsolami, and A. Ghosh, "Electrically actuated visible and near-infrared regulating switchable smart window for energy positive building: A review," *Journal of Cleaner Production,* vol. 301, p. 126854, 2021.

[218] J. Mandal *et al.*, "Hierarchically porous polymer coatings for highly efficient passive daytime radiative cooling," *Science,* vol. 362, no. 6412, pp. 315-319, 2018.

[219] X. Lu, P. Xu, H. Wang, T. Yang, and J. Hou, "Cooling potential and applications prospects of passive radiative cooling in buildings: The current state-of-the-art," *Renewable and Sustainable Energy Reviews,* vol. 65, pp. 1079-1097, 2016.

[220] G. K. Dalapati *et al.*, "Color tunable low cost transparent heat reflector using copper and titanium oxide for energy saving application," *Scientific reports,* vol. 6, no. 1, p. 20182, 2016.

[221] G. K. Dalapati *et al.*, "Transparent heat regulating (THR) materials and coatings for energy saving window applications: Impact of materials design, micro-structural, and interface quality on the THR performance," *Progress in materials science,* vol. 95, pp. 42-131, 2018.

[222] J. H. Kwon, S. Choi, Y. Jeon, H. Kim, K. S. Chang, and K. C. Choi, "Functional design of dielectric–metal–dielectric-based thin-film encapsulation with heat transfer and flexibility for flexible displays," *ACS Applied Materials & Interfaces,* vol. 9, no. 32, pp. 27062-27072, 2017.

[223] M. Butt, S. Fomchenkov, and S. Khonina, "Dielectric-Metal-Dielectric (DMD) infrared (IR) heat reflectors," in *Journal of Physics: Conference Series*, 2017, vol. 917, no. 6: IOP Publishing, p. 062007.

[224] M. Al-Kuhaili, A. Al-Aswad, S. Durrani, and I. Bakhtiari, "Energy-saving transparent heat mirrors based on tungsten oxide–gold WO3/Au/WO3 multilayer structures," *Solar energy,* vol. 86, no. 11, pp. 3183-3189, 2012.

[225] T. D. Nguyen *et al.*, "Electrochromic smart glass coating on functional nano-frameworks for effective building energy conservation," *Materials Today Energy,* vol. 18, p. 100496, 2020.

[226] Y. Yang *et al.*, "Triboelectric nanogenerator enabled wearable sensors and electronics for sustainable internet of things integrated green earth," *Advanced Energy Materials,* vol. 13, no. 1, p. 2203040, 2023.

[227] D. Wang, G. Chen, and J. Fu, "Multifunctional thermochromic smart windows for building energy saving," *Journal of Materials Chemistry A,* vol. 12, no. 22, pp. 12960-12982, 2024.

[228] H. Peng *et al.*, "Dynamically Tunable Thermochromic Smart Windows for Building Energy Conservation," *ACS Materials Letters,* vol. 6, no. 8, pp. 3404-3413, 2024.

[229] Z. Shao *et al.*, "Tri-band electrochromic smart window for energy savings in buildings," *Nature Sustainability,* vol. 7, no. 6, pp. 796-803, 2024.

[230] X. Geng *et al.*, "Tuning phase transition and thermochromic properties of vanadium dioxide thin films via cobalt doping," *ACS Applied Materials & Interfaces,* vol. 14, no. 17, pp. 19736-19746, 2022.

[231] L. Calvi *et al.*, "A comparative study on the switching kinetics of W/VO2 powders and VO2 coatings and their implications for thermochromic glazing," *Solar Energy Materials and Solar Cells,* vol. 224, p. 110977, 2021.

[232] Y. Ke *et al.*, "Cephalopod-inspired versatile design based on plasmonic VO2 nanoparticle for energy-efficient mechano-thermochromic windows," *Nano Energy,* vol. 73, p. 104785, 2020.

[233] Z. Zhao *et al.*, "Sn–W Co-doping improves thermochromic performance of VO2 films for smart windows," *ACS Applied Energy Materials,* vol. 3, no. 10, pp. 9972-9979, 2020.

[234] M. Azmat *et al.*, "Samarium-doped vanadium dioxide thin films to modulate the thermochromic properties for energy-saving smart windows," *ACS Applied Energy Materials,* vol. 7, no. 9, pp. 3776-3786, 2024.

[235] S. Barinova, Y.-W. Wu, S.-H. Yang, and I. Abdulhalim, "Metamaterial hybrid smart window based on nanoporous VO2 microparticles in liquid crystal for heat blocking and visibility control," *ACS Applied Energy Materials,* vol. 6, no. 14, pp. 7587-7595, 2023.

[236] L. Wu *et al.*, "Kirkendall effect induced ultrafine VOOH nanoparticles and their transformation into VO 2 (M) for energy-efficient smart windows," *Materials Horizons,* vol. 11, no. 4, pp. 1098-1107, 2024.

[237] N. Wang, Q. S. Goh, P. L. Lee, S. Magdassi, and Y. Long, "One-step hydrothermal synthesis of rare earth/W-codoped VO2 nanoparticles: Reduced phase transition temperature and improved thermochromic properties," *Journal of Alloys and Compounds,* vol. 711, pp. 222-228, 2017.

[238] R. Guo *et al.*, "Phase-change materials for intelligent temperature regulation," *Materials Today Energy,* vol. 23, p. 100888, 2022.

[239] J. Li *et al.*, "A photosynthetically active radiative cooling film," *Nature Sustainability,* vol. 7, no. 6, pp. 786-795, 2024.

[240] Y. Jiao *et al.*, "Flexible tri-state-regulated thermochromic smart window based on WxV1-xO2/paraffin/PVA composite film," *Chemical Engineering Journal,* vol. 497, p. 154578, 2024.

[241] S. Lin *et al.*, "Direct spray-coating of highly robust and transparent Ag nanowires for energy saving windows," *Nano Energy,* vol. 62, pp. 111-116, 2019.

[242] Y. Li, X. Chen, L. Yu, D. Pang, H. Yan, and M. Chen, "Janus interface engineering boosting visibly transparent radiative cooling for energy saving," *ACS Applied Materials & Interfaces,* vol. 15, no. 3, pp. 4122-4131, 2023.

[243] S. H. Kim, M. Kim, J. H. Lee, and S.-J. Lee, "Self-cleaning transparent heat mirror with a plasma polymer fluorocarbon thin film fabricated by a continuous roll-to-roll sputtering process," *ACS applied materials & interfaces,* vol. 10, no. 12, pp. 10454-10460, 2018.

[244] H.-C. Chu *et al.*, "Spray-deposited large-area copper nanowire transparent conductive electrodes and their uses for touch screen applications," *ACS applied materials & interfaces,* vol. 8, no. 20, pp. 13009-13017, 2016.

[245] J. Lee *et al.*, "Room-temperature nanosoldering of a very long metal nanowire network by conducting-polymer-assisted joining for a flexible touch-panel application," *Advanced Functional Materials,* vol. 23, no. 34, pp. 4171-4176, 2013.

[246] T. Shimura *et al.*, "A high-resolution, transparent, and stretchable polymer conductor for wearable sensor arrays," *Advanced Materials Technologies,* vol. 8, no. 12, p. 2201992, 2023.

[247] X.-Y. Yin, Y. Zhang, X. Cai, Q. Guo, J. Yang, and Z. L. Wang, "3D printing of ionic conductors for high-sensitivity wearable sensors," *Materials Horizons,* vol. 6, no. 4, pp. 767-780, 2019.

[248] Z. H. Chen, R. Fang, W. Li, and J. Guan, "Stretchable transparent conductors: from micro/macromechanics to applications," *Advanced Materials,* vol. 31, no. 35, p. 1900756, 2019.

[249] J. Lee *et al.*, "Semitransparent perovskite solar cells with enhanced light utilization efficiencies by transferable Ag nanogrid electrodes," *ACS Applied Materials & Interfaces,* vol. 13, no. 49, pp. 58475-58485, 2021.

[250] S. Lin *et al.*, "Roll-to-roll production of transparent silver-nanofiber-network electrodes for flexible electrochromic smart windows," *Advanced materials,* vol. 29, no. 41, p. 1703238, 2017.

[251] J. K. Wassei and R. B. Kaner, "Graphene, a promising transparent conductor," *Materials today,* vol. 13, no. 3, pp. 52-59, 2010.

[252] C. Mancarella, M. Sygletou, B. R. Bricchi, F. Bisio, and A. Li Bassi, "Tunable optical and plasmonic response of Au nanoparticles embedded in Ta-doped TiO 2 transparent conducting films," *Physical Review Materials,* vol. 6, no. 2, p. 025201, 2022.

[253] T. Kim, A. Canlier, C. Cho, V. Rozyyev, J.-Y. Lee, and S. M. Han, "Highly transparent Au-coated Ag nanowire transparent electrode with reduction in haze," *ACS applied materials & interfaces,* vol. 6, no. 16, pp. 13527-13534, 2014.

[254] T.-B. Song *et al.*, "Highly robust silver nanowire network for transparent electrode," *ACS applied materials & interfaces,* vol. 7, no. 44, pp. 24601-24607, 2015.

[255] B. Bari *et al.*, "Simple hydrothermal synthesis of very-long and thin silver nanowires and their application in high quality transparent electrodes," *Journal of Materials Chemistry A,* vol. 4, no. 29, pp. 11365-11371, 2016.

[256] A. R. Rathmell, S. M. Bergin, Y. L. Hua, Z. Y. Li, and B. J. Wiley, "The growth mechanism of copper nanowires and their properties in flexible, transparent conducting films," *Advanced materials,* vol. 22, no. 32, pp. 3558-3563, 2010.

[257] X. Lu, Y. Zhang, and Z. Zheng, "Metal-based flexible transparent electrodes: challenges and recent advances," *Advanced Electronic Materials,* vol. 7, no. 5, p. 2001121, 2021.

[258] J. Liu, D. Jia, J. M. Gardner, E. M. Johansson, and X. Zhang, "Metal nanowire networks: Recent advances and challenges for new generation photovoltaics," *Materials Today Energy,* vol. 13, pp. 152-185, 2019.

[259] X. Ma, Y. Li, I. Hussain, R. Shen, G. Yang, and K. Zhang, "Core–shell structured nanoenergetic materials: preparation and fundamental properties," *Advanced Materials,* vol. 32, no. 30, p. 2001291, 2020.

[260] Z. Ren *et al.*, "Core-shell TiO2@ Au nanofibers derived from a unique physical coating strategy for excellent capacitive energy storage nanocomposites," *Advanced Functional Materials,* vol. 34, no. 36, p. 2401907, 2024.

[261] S. Yuan, X. Li, X. Zhang, and Y. Jia, "Fabrication of Au–Ag bimetallic nanostructures through the galvanic replacement reaction of block copolymer-stabilized Ag nanoparticles with HAuCl4," *Science of Advanced Materials,* vol. 7, no. 5, pp. 918-923, 2015.

[262] A. N. Koya *et al.*, "Nanoporous metals: From plasmonic properties to applications in enhanced spectroscopy and photocatalysis," *ACS nano,* vol. 15, no. 4, pp. 6038-6060, 2021.

[263] P. Singh, T. A. König, and A. Jaiswal, "NIR-active plasmonic gold nanocapsules synthesized using thermally induced seed twinning for surface-enhanced raman scattering applications," *ACS applied materials & interfaces,* vol. 10, no. 45, pp. 39380-39390, 2018.

[264] U. Pandey, A. K. Yadav, N. Pal, P. K. Aich, and B. N. Pal, "Enhanced sub-band gap photosensitivity by an asymmetric source–drain electrode low operating voltage oxide transistor," *Journal of Materials Chemistry C,* vol. 11, no. 43, pp. 15276-15287, 2023.

[265] J. Miao and T. Fan, "Flexible and stretchable transparent conductive graphene-based electrodes for emerging wearable electronics," *Carbon,* vol. 202, pp. 495-527, 2023.

[266] D. S. Ginley and J. D. Perkins, "Transparent conductors," in *Handbook of transparent conductors*: Springer, 2010, pp. 1-25.

[267] M. Morales-Masis, S. De Wolf, R. Woods-Robinson, J. W. Ager, and C. Ballif, "Transparent electrodes for efficient optoelectronics," *Advanced Electronic Materials,* vol. 3, no. 5, p. 1600529, 2017.

[268] Q. Tai and F. Yan, "Emerging semitransparent solar cells: materials and device design," *Advanced Materials,* vol. 29, no. 34, p. 1700192, 2017.

[269] D. Won *et al.*, "Transparent electronics for wearable electronics application," *Chemical Reviews,* vol. 123, no. 16, pp. 9982-10078, 2023.

[270] K. Salimi, A. Atilgan, M. Y. Aydin, H. Yildirim, N. Celebi, and A. Yildiz, "Plasmonic mesoporous core-shell Ag-Au@ TiO2 photoanodes for efficient light harvesting in dye sensitized solar cells," *Solar Energy,* vol. 193, pp. 820-827, 2019.

[271] R. Borah and S. W. Verbruggen, "Silver–gold bimetallic alloy versus core–shell nanoparticles: implications for plasmonic enhancement and photothermal applications," *The Journal of Physical Chemistry C,* vol. 124, no. 22, pp. 12081-12094, 2020.

[272] X. Liu *et al.*, "Synthesis of thermally stable and highly active bimetallic Au− Ag nanoparticles on inert supports," *Chemistry of Materials,* vol. 21, no. 2, pp. 410-418, 2009.

[273] Z. Tang, W. Tress, and O. Inganäs, "Light trapping in thin film organic solar cells," *Materials today,* vol. 17, no. 8, pp. 389-396, 2014.

[274] A. Peter Amalathas and M. M. Alkaisi, "Nanostructures for light trapping in thin film solar cells," *Micromachines,* vol. 10, no. 9, p. 619, 2019.

[275] E. L. Lim, C. C. Yap, M. A. M. Teridi, C. H. Teh, A. R. bin Mohd Yusoff, and M. H. H. Jumali, "A review of recent plasmonic nanoparticles incorporated P3HT: PCBM organic thin film solar cells," *Organic Electronics,* vol. 36, pp. 12-28, 2016.

[276] K. L. Kelly, E. Coronado, L. L. Zhao, and G. C. Schatz, "The optical properties of metal nanoparticles: the influence of size, shape, and dielectric environment," vol. 107, ed: ACS Publications, 2003, pp. 668-677.

[277] R. A. Pala, J. White, E. Barnard, J. Liu, and M. L. Brongersma, "Design of plasmonic thin-film solar cells with broadband absorption enhancements," *Adv. Mater,* vol. 21, no. 34, pp. 3504-3509, 2009.

[278] X. Huang, S. Han, W. Huang, and X. Liu, "Enhancing solar cell efficiency: the search for luminescent materials as spectral converters," *Chemical Society Reviews,* vol. 42, no. 1, pp. 173-201, 2013.

[279] E. K. Solak and E. Irmak, "Advances in organic photovoltaic cells: a comprehensive review of materials, technologies, and performance," *RSC advances,* vol. 13, no. 18, pp. 12244-12269, 2023.

[280] J. Panidi, D. G. Georgiadou, T. Schoetz, and T. Prodromakis, "Advances in organic and perovskite photovoltaics enabling a greener Internet of Things," *Advanced Functional Materials,* vol. 32, no. 23, p. 2200694, 2022.

[281] G. Bernardo, T. Lopes, D. G. Lidzey, and A. Mendes, "Progress in upscaling organic photovoltaic devices," *Advanced Energy Materials,* vol. 11, no. 23, p. 2100342, 2021.

[282] C. W. Tang, "Two-layer organic photovoltaic cell," *Applied physics letters,* vol. 48, no. 2, pp. 183-185, 1986.

[283] S. Park, T. Kim, S. Yoon, C. W. Koh, H. Y. Woo, and H. J. Son, "Progress in materials, solution processes, and long-term stability for large-area organic photovoltaics," *Advanced Materials,* vol. 32, no. 51, p. 2002217, 2020.

[284] G. Wang, M. A. Adil, J. Zhang, and Z. Wei, "Large-area organic solar cells: material requirements, modular designs, and printing methods," *Advanced Materials,* vol. 31, no. 45, p. 1805089, 2019.

[285] N. Kalfagiannis *et al.*, "Plasmonic silver nanoparticles for improved organic solar cells," *Solar Energy Materials and Solar Cells,* vol. 104, pp. 165-174, 2012.

[286] J. Wang *et al.*, "Effect of plasmonic Au nanoparticles on inverted organic solar cell performance," *The Journal of Physical Chemistry C,* vol. 117, no. 1, pp. 85-91, 2013.

[287] M. Notarianni, K. Vernon, A. Chou, M. Aljada, J. Liu, and N. Motta, "Plasmonic effect of gold nanoparticles in organic solar cells," *Solar Energy,* vol. 106, pp. 23-37, 2014.

[288] X. Li, W. C. H. Choy, H. Lu, W. E. Sha, and A. H. P. Ho, "Efficiency enhancement of organic solar cells by using shape-dependent broadband plasmonic absorption in metallic nanoparticles," *Advanced Functional Materials,* vol. 23, no. 21, pp. 2728-2735, 2013.

[289] M. Omrani, H. Fallah, K.-L. Choy, and M. Abdi-Jalebi, "Impact of hybrid plasmonic nanoparticles on the charge carrier mobility of P3HT: PCBM polymer solar cells," *Scientific reports,* vol. 11, no. 1, p. 19774, 2021.

[290] L. Tzounis, C. Gravalidis, A. Papamichail, and S. Logothetidis, "Enhancement of P3HT: PCBM photovoltaic shells efficiency incorporating core-shell Au@ Ag plasmonic nanoparticles," *Materials Today: Proceedings,* vol. 3, no. 3, pp. 832-839, 2016.

[291] H. Kaçuş, M. Biber, and Ş. Aydoğan, "Role of the Au and Ag nanoparticles on organic solar cells based on P3HT: PCBM active layer," *Applied Physics A,* vol. 126, no. 10, p. 817, 2020.

[292] S. Sanad, A. M. Ghanim, N. Gad, M. El-Aasser, A. Yahia, and M. A. Swillam, "Enhanced light harvesting in PM6: Y6 organic solar cells using plasmonic nanostructures," in *Smart Materials for Opto-Electronic Applications*, 2023, vol. 12584: SPIE, pp. 133-137.

[293] T. Das, A. Kumar, S. Rani, A. Guchhait, and D. S. Ghosh, "Fabrication of highly efficient and ambient stable planar MAPbI3 perovskite solar cells via defect passivation through crosslinking strategy," *Advanced Engineering Materials,* vol. 26, no. 8, p. 2302078, 2024.

[294] D. Li, Y. Sun, J. Pei, X. Yu, Z. Tian, and H. Xu, "Au-SnO2 resonator for SERS detection of ciprofloxacin," *Microchemical Journal,* vol. 203, p. 110830, 2024.

[295] A. M. Ismail, E. Csapó, and C. Janáky, "Correlation between the work function of Au–Ag nanoalloys and their electrocatalytic activity in carbon dioxide reduction," *Electrochimica Acta,* vol. 313, pp. 171-178, 2019.

[296] M. Abdallaoui, N. Sengouga, A. Chala, A. Meftah, and A. Meftah, "Comparative study of conventional and inverted P3HT: PCBM organic solar cell," *Optical Materials,* vol. 105, p. 109916, 2020.

[297] A. Iwan *et al.*, "Electrochemical and photocurrent characterization of polymer solar cells with improved performance after GO addition to the PEDOT: PSS hole transporting layer," *Solar Energy,* vol. 146, pp. 230-242, 2017.

[298] X. X. Han, R. S. Rodriguez, C. L. Haynes, Y. Ozaki, and B. Zhao, "Surface-enhanced Raman spectroscopy," *Nature Reviews Methods Primers,* vol. 1, no. 1, p. 87, 2021.

[299] A. Korkmaz, M. Kenton, G. Aksin, M. Kahraman, and S. Wachsmann-Hogiu, "Inexpensive and flexible SERS substrates on adhesive tape based on biosilica plasmonic nanocomposites," *ACS Applied Nano Materials,* vol. 1, no. 9, pp. 5316-5326, 2018.

[300] J. Bar *et al.*, "Silicon microchannel-driven Raman scattering enhancement to improve gold nanorod functions as a SERS substrate toward single-molecule detection," *ACS Applied Materials & Interfaces,* vol. 13, no. 30, pp. 36482-36491, 2021.

[301] K. Kneipp *et al.*, "Single molecule detection using surface-enhanced Raman scattering (SERS)," *Physical review letters,* vol. 78, no. 9, p. 1667, 1997.

[302] L. Zhang, C. Guan, Y. Wang, and J. Liao, "Highly effective and uniform SERS substrates fabricated by etching multi-layered gold nanoparticle arrays," *Nanoscale,* vol. 8, no. 11, pp. 5928-5937, 2016.

[303] S. Huang, C. Wu, Y. Wang, X. Yang, R. Yuan, and Y. Chai, "Ag/TiO2 nanocomposites as a novel SERS substrate for construction of sensitive biosensor," *Sensors and Actuators B: Chemical,* vol. 339, p. 129843, 2021.

[304] X. Zhao *et al.*, "High-performance SERS substrate based on hierarchical 3D Cu nanocrystals with efficient morphology control," *Small,* vol. 14, no. 38, p. 1802477, 2018.

[305] L. Zhang, T. Liu, K. Liu, L. Han, Y. Yin, and C. Gao, "Gold nanoframes by nonepitaxial growth of Au on AgI nanocrystals for surface-enhanced Raman spectroscopy," *Nano letters,* vol. 15, no. 7, pp. 4448-4454, 2015.

[306] H. Zhang *et al.*, "Physical deposition improved SERS stability of morphology controlled periodic micro/nanostructured arrays based on colloidal templates," *Small,* vol. 11, no. 7, pp. 844-853, 2015.

[307] Y.-J. Yeh, C.-J. Cho, J.-S. Benas, K.-L. Tung, C.-C. Kuo, and W.-H. Chiang, "Plasma-engineered plasmonic nanoparticle-based stretchable nanocomposites as sensitive wearable SERS sensors," *ACS Applied Nano Materials,* vol. 6, no. 12, pp. 10115-10125, 2023.

[308] T.-J. Wang, N. R. Barveen, Z.-Y. Liu, C.-H. Chen, and M.-H. Chou, "Transparent, flexible plasmonic Ag NP/PMMA substrates using chemically patterned ferroelectric crystals for detecting pesticides on curved surfaces," *ACS Applied Materials & Interfaces,* vol. 13, no. 29, pp. 34910-34922, 2021.

[309] J. Wang, K. M. Koo, Y. Wang, and M. Trau, "Engineering state-of-the-art plasmonic nanomaterials for SERS-based clinical liquid biopsy applications," *Advanced Science,* vol. 6, no. 23, p. 1900730, 2019.

[310] B. A. Yusuf *et al.*, "Rational design of noble metal-based multimetallic nanomaterials: A review," *Nano Energy,* vol. 104, p. 107959, 2022.

[311] G. Sharma *et al.*, "Revolution from monometallic to trimetallic nanoparticle composites, various synthesis methods and their applications: A review," *Materials Science and Engineering: C,* vol. 71, pp. 1216-1230, 2017.

[312] M. Fan, F.-J. Lai, H.-L. Chou, W.-T. Lu, B.-J. Hwang, and A. G. Brolo, "Surface-enhanced Raman scattering (SERS) from Au: Ag bimetallic nanoparticles: the effect of the molecular probe," *Chemical Science,* vol. 4, no. 1, pp. 509-515, 2013.

[313] K. Liu *et al.*, "Porous Au–Ag nanospheres with high-density and highly accessible hotspots for SERS analysis," *Nano letters,* vol. 16, no. 6, pp. 3675-3681, 2016.

[314] H.-l. Hao, J. Zhu, G.-j. Weng, J.-j. Li, Y.-b. Guo, and J.-w. Zhao, "Exclusive core-Janus satellite assembly based on Au–Ag Janus self-aligned distributions with abundant hotspots for ultrasensitive detection of CA19-9," *ACS sensors,* vol. 9, no. 2, pp. 942-954, 2024.

[315] H. Kang *et al.*, "Stabilization of silver and gold nanoparticles: preservation and improvement of plasmonic functionalities," *Chemical reviews,* vol. 119, no. 1, pp. 664-699, 2018.

[316] Y. Yang *et al.*, "Controlled growth of Ag/Au bimetallic nanorods through kinetics control," *Chemistry of Materials,* vol. 25, no. 1, pp. 34-41, 2013.

[317] D. Chateau *et al.*, "From gold nanobipyramids to nanojavelins for a precise tuning of the plasmon resonance to the infrared wavelengths: experimental and theoretical aspects," *Nanoscale,* vol. 7, no. 5, pp. 1934-1943, 2015.

[318] W. Xiong, R. Mazid, L. W. Yap, X. Li, and W. Cheng, "Plasmonic caged gold nanorods for near-infrared light controlled drug delivery," *Nanoscale,* vol. 6, no. 23, pp. 14388-14393, 2014.

[319] M. Mayer, M. J. Schnepf, T. A. König, and A. Fery, "Colloidal Self-Assembly Concepts for Plasmonic Metasurfaces," *Advanced Optical Materials,* vol. 7, no. 1, p. 1800564, 2019.

[320] C. Li, L. Sun, Y. Sun, and T. Teranishi, "One-pot controllable synthesis of Au@ Ag heterogeneous nanorods with highly tunable plasmonic absorption," *Chemistry of Materials,* vol. 25, no. 13, pp. 2580-2590, 2013.

[321] C. L. Haynes, A. D. McFarland, and R. P. Van Duyne, "Surface-enhanced Raman spectroscopy," ed: ACS Publications, 2005.

[322] A. Campion and P. Kambhampati, "Surface-enhanced Raman scattering," *Chemical society reviews,* vol. 27, no. 4, pp. 241-250, 1998.

[323] S. Abalde-Cela, S. Carregal-Romero, J. P. Coelho, and A. Guerrero-Martínez, "Recent progress on colloidal metal nanoparticles as signal enhancers in nanosensing," *Advances in colloid and interface science,* vol. 233, pp. 255-270, 2016.

[324] Y. Liu, H. Ma, X. X. Han, and B. Zhao, "Metal–semiconductor heterostructures for surface-enhanced Raman scattering: synergistic contribution of plasmons and charge transfer," *Materials horizons,* vol. 8, no. 2, pp. 370-382, 2021.

[325] K. Zhang *et al.*, "Synthesis of a Gold–Metal Oxide Core–Satellite Nanostructure for In Situ SERS Study of CuO-Catalyzed Photooxidation," *Angewandte Chemie,* vol. 132, no. 41, pp. 18159-18165, 2020.

[326] S. Cong *et al.*, "Noble metal-comparable SERS enhancement from semiconducting metal oxides by making oxygen vacancies," *Nature communications,* vol. 6, no. 1, p. 7800, 2015.

[327] L. Yang *et al.*, "Charge-transfer-induced surface-enhanced Raman scattering on Ag– TiO2 nanocomposites," *The Journal of Physical Chemistry C,* vol. 113, no. 36, pp. 16226-16231, 2009.

[328] Y. Huang, S. Zhang, S. Jiang, and J. Xu, "Improved SERS Performance on Ag-Coated Amorphous TiO2 Random Nanocavities by the Enhanced Light–Matter Coupling Effect," *ACS Sustainable Chemistry & Engineering,* vol. 12, no. 8, pp. 3234-3242, 2024.

[329] Y. Wang *et al.*, "Effect of TiO2 arrays on surface enhanced Raman scattering (SERS) performance for Ag/TiO2 substrates," *Nanotechnology,* vol. 32, no. 7, p. 075708, 2020.

[330] J. Colin *et al.*, "In situ and real-time nanoscale monitoring of ultra-thin metal film growth using optical and electrical diagnostic tools," *Nanomaterials,* vol. 10, no. 11, p. 2225, 2020.

[331] L. Zhu, Z. Meng, S. Hu, T. Zhao, and B. Zhao, "Understanding metal–semiconductor plasmonic resonance coupling through surface-enhanced Raman scattering," *ACS Applied Materials & Interfaces,* vol. 15, no. 18, pp. 22730-22736, 2023.

[332] X. Wang, E. Zhang, H. Shi, Y. Tao, and X. Ren, "Semiconductor-based surface enhanced Raman scattering (SERS): from active materials to performance improvement," *Analyst,* vol. 147, no. 7, pp. 1257-1272, 2022.

[333] J. R. Lombardi and R. L. Birke, "Theory of surface-enhanced Raman scattering in semiconductors," *The Journal of Physical Chemistry C,* vol. 118, no. 20, pp. 11120-11130, 2014.

[334] X. X. Han, W. Ji, B. Zhao, and Y. Ozaki, "Semiconductor-enhanced Raman scattering: active nanomaterials and applications," *Nanoscale,* vol. 9, no. 15, pp. 4847-4861, 2017.

[335] B. P. Majee, V. Srivastava, and A. K. Mishra, "Surface-enhanced Raman scattering detection based on an interconnected network of vertically oriented semiconducting few-layer MoS2 nanosheets," *ACS Applied Nano Materials,* vol. 3, no. 5, pp. 4851-4858, 2020.

[336] J. R. Lombardi and R. L. Birke, "A unified view of surface-enhanced Raman scattering," *Accounts of chemical research,* vol. 42, no. 6, pp. 734-742, 2009.

[337] A. Singh and A. K. Mishra, "Large area CVD-grown vertically and horizontally oriented MoS 2 nanostructures as SERS biosensors for single molecule detection," *Nanoscale,* vol. 15, no. 40, pp. 16480-16492, 2023.

[338] Y. Wang, J. Liu, Y. Ozaki, Z. Xu, and B. Zhao, "Effect of TiO2 on Altering Direction of Interfacial Charge Transfer in a TiO2-Ag-MPY-FePc System by SERS," *Angewandte Chemie International Edition,* vol. 58, no. 24, pp. 8172-8176, 2019.

[339] H. Kim, D.-H. Lee, and Y.-A. Son, "Electrochemical study on rhodamine 6G-indole based dye for HOMO and LUMO energy levels," *Textile Coloration and Finishing,* vol. 25, no. 1, pp. 7-12, 2013.

[340] Y. Quan *et al.*, "Interface synthesis of MoS2@ ZnO@ Ag SERS substrate for the ultrasensitive determination of bilirubin," *Applied Surface Science,* vol. 598, p. 153750, 2022.

[341] D. Xu, L. Duan, W. Jia, G. Yang, and Y. Gu, "Fabrication of Ag@ Fe2O3 hybrid materials as ultrasensitive SERS substrates for the detection of organic dyes and bilirubin in human blood," *Microchemical Journal,* vol. 161, p. 105799, 2021.

[342] A. R. Paloly, K. Anju, and M. J. Bushiri, "High sensitive and reusable SERS substrate based on Ag/SnO2 nanocone arrayed thin film," *Plasmonics,* vol. 17, no. 5, pp. 2187-2196, 2022.

[343] U. Qamar, S. Hazra, C. Kant, U. U. Ghosh, B. N. Pal, and S. Das, "Two-dimensional silver nanonetwork on Ag4Ti5O12 film as highly efficient SERS substrate," *Microchemical Journal,* vol. 196, p. 109686, 2024.

[344] S. Mao *et al.*, "Detection of trace Rhodamine B using stable, uniformity, and reusable SERS substrate based on Ag@ SiO2-Au nanoparticles," *Colloids and Surfaces A: Physicochemical and Engineering Aspects,* vol. 657, p. 130595, 2023.

List of Publications and Patents

Publications:

1. **Hazra S,** Singh SV, Dahiya S, Aich PK, Pal BN. Solution Processed Ag-TiO_2 Nanostructure-Based Schottky Junction Thin Films for Narrowband Hot-Electron Photodetectors. **ACS Applied Nano Materials. 2023;6(16):15119-15127**
2. **Hazra S,** Dahiya S, Singh SV, Pandey U, Suman S, Swaminathan P, Pal BN. Flexible Transparent Conductors with a percolated Ag nanostructure and its Application as Efficient Self-bias Plasmonic Photodetector. **Chemical Engineering Journal. 2024; 498;155313.**
3. **Hazra S,** Dahiya S, Bijarniya JP, Pramanik S, Pal BN. Cost Efficient Ag/Ag-TiO_2 Coating Based Flexible Transparent Heat Reflector for Energy-Saving Smart Window. **ACS Applied Energy Materials. 2024;7(17);7316-7324.**
4. Qamar U#, **Hazra S#**, Kant C, Ghosh UU, Pal BN, Das S. Two-dimensional silver nanonetwork on $Ag_4Ti_5O_{12}$ film as highly efficient SERS substrate. **Microchemical Journal. 2024;196;109686 (# Equal Contribution)**
5. Pradhan L, **Hazra S#**, Manna S, Pal BN, Mukherjee S. Screening of Lithium substituted Ag-TiO_2 nanoparticles coating for antibiofilm application. **ACS applied Bio Materials. 2024. (# Equal Contribution)**
6. **Hazra S,** Dahiya S, Pramanik S, Chakraborty R, Pal BN. Visible to IR Active Highly Transparent Plasmonic Au-Ag Bimetallic Conducting Film and its Application as an efficient Plasmonic Photodetector on Plastic Substrate **(under review)**
7. **Hazra S#,** Jangra P#, Dahiya S, Mishra AK, Pal BN. Highly Sensitive Plasmonic Au-Ag Bimetallic Nano-Film as Flexible SERS Biosensors for Detection of single molecule R6G dye & multi-molecules Vitamin B_{12} **(under review)**

8. **Hazra S,** Dahiya S, Pramanik S, Chetri P, Pal BN. Improve efficiency of Plasmonic organic solar cell using Au-Ag bimetallic transparent conducting film as a Back Electrode **(under review)**

9. Singh SV**, Hazra S,** Dahiya S, Pandey U, Pal BN. Plasmonic hot-electron induced narrowband photodetector by using in-situ grown Ag/TiO_2 nano heterojunction thin films. **Optical Materials. 2024; 148:114874.**

10. Thakurta B**, Hazra S,** Samanta A, Singh AK, Nasir A, Mourya D, Mandal BC, Giri A, Pal BN, Pal M. One-Step Room Temperature Synthesis of Printable Carbon Quantum Dots Ink for Visual Encryption and High Performance Photodetector. **Advanced Optical Material. 2024; 202401886.**

11. Pradhan L**, Hazra S,** Singh SV, Bajrang, Upadhaya A, Pal BN, Mukherjee S. Surface Modification of Medical Grade Biomaterials by Using Low-Temperature Processed Dual Functional Ag-TiO_2 coating for preventing Biofilm Formation. **Journal of Material Chemistry B. 2024,12, 10093-10109.**

12. Pramanik S, Chakraborty **R, Hazra S,** Pandey U, Pal BN. Enhanced memory performance with ion exchange and reduction in Ag-doped Memristors**. Journal of Material Chemistry C. 2024,12,16145-16155.**

13. Dahiya S**, Hazra S,** Pandey U, Pramanik S, Dahiya P, Singh SV, Kumari N, Pal BN. Enhancement in photo-response of CuZnS nanocrystals-based photodetector using asymmetric work function electrode**s. Optical Materials, 2024; 157(1),116182.**

14. Dahiya S, Singh SV, Pandey U, **Hazra S,** Pal BN. Microwave-Assisted Synthesis of CuZnS Nanocrystals for Spectrally Flat Visible Light Photodetector Application Using a ZnO/CuZnS Heterojunctio**n. ACS Applied Optical Materials. 2024;2(5):776-783.**

15. Suresh S, Subramaniam MR**, Hazra S,** Pal BN, Batabyal SK. Solvent evaporation induced large-scale synthesis of Cs_4PbBr_6 and $CsPbBr_3$ microcrystals: Optical properties and backlight application for LEDs**. ACS omega. 2023;8(5):4616-4626.**

16. Dahiya S, Pandey U, **Hazra S,** Chakraborty R, Pramanik S, Maurya P.P, Pal BN. High-Performance Broadband Photodetector with Lateral Contact of n^+-Si Wafer by Two Asymmetric Work-Function Electrodes. **Advanced Materials Technologies. 2024; 2401532.**

17. Pandey U, Pal N, Dahiya S, **Hazra S,** Pal BN. Self-Biased Silicon Transistor with a Piezoelectric Gate for Efficient Mechanical Energy Harvesting Device. **Nanoscale. 2025.**

18. Gupta N, Anamika, Maurya A, **Hazra S,** Pal BN, Kuila BK. Donor acceptor hybrid between a conjugated linear polymer and conjugated polymer network: Improved charge separation and application to high-performance all polymer photodetector. **(accepted in ACS Appl. Polym. Mater. 2025)**

19. Pandey U, Dahiya S, Chakraborty R, Pramanik S, **Hazra S,** Pal BN. Piezopotential Gated Self-Biased Conducting Polymer based Printable Transistor for Efficient Mechanical Energy Harvesting Device. **ACS Appl. Mater. Interfaces. 2025.**

20. Majhi S, **Hazra S,** Pal BN, Giri D. Inverse Vulcanized Sulfur with Vinylic Monomer: A Thin Film Polymer for Photodetector Application. **(under review)**

21. Pramanik S, Chakraborty R, **Hazra S,** Pal BN. Emulating synaptic plasticity in brain-inspired optoelectronic Ag-based oxide memristor for high-accuracy neuromorphic computing **(under review)**

22. Pramanik S, Chakraborty R, **Hazra S,** Panpalia S, Pal BN. LiV_3O_8 thin film for Non-Volatile Resistive Memory Devices and Broadband Photodetectors. **(manuscript under process)**

23. Pramanik S, Chakraborty R, **Hazra S,** Dahiya S, Pal BN. Emulating High Memory Performance in Ionic and Metallic Ag-doped Oxide Memristors. **(manuscript under process)**

Patents:

1. **<u>Hazra S</u>,** Pal BN. "A SUPERCONDUCTIVE MESOSCOPIC FILM AND A METHOD OF FABRICATION THERE OF"; 2023/7/10; P.2780.IN; **Application No-202311046399; Grant No-558639**
2. **<u>Hazra S</u>,** Dahiya S, Pal BN**.** "A METHOD OF FABRICATION OF A MULTILAYERED TRANSPARENT FILM AND A PRODUCT THEREOF"; 2024/6/13; P.3042.IN**; Application No-202411045664; Grant No-569634**
3. **<u>Hazra S</u>,** Pradhan L, Pal BN**,** Mukherjee S**. "**AN ANTI-BACTERIAL AND ANTI-BIOFILM SURFACE COATING AND A METHOD OF FABRICATION THEREOF"; 2024/12/30; P.3254.IN; **Application No- 202411045664**