

to solvent was varied to study its effect on the length-scale parameters of dewetting i.e., the instability wavelength( $\lambda$ ) and droplet diameter( $d$ ).

**Chapter 3** discusses the effect of modulating the surface properties of the substrate on the length-scales of dewetting in water-solvent induced self-organized dewetting of thin polystyrene films. Here, Octadecyltrichlorosilane (OTS) self-assembled monolayer was deposited on cleaned glass substrates under low-pressure in dessicator. Further, the silanized substrates are coated with Polystyrene thin film and then immersed into an optimal mixture of good solvent and non-solvent. The effect of surface hydrophobicity on the length scale parameters of dewetting of thin Polystyrene film is investigated.

**Chapter 4** discusses the formation of aligned droplets by dewetting of electrospinned Polystyrene nanofibers and its comparison with Rayleigh-Plateau's model. Instead, of using film configuration, we had used fiber configuration to get more aligned deposition of nanostructures. The film is initially deposited with fibers and then dewetted and after dewetting again the film is deposited with fibers. Dewetting of fibers on previously dewetted substrates will increase the fiber density.

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It has been found that due to increase in the solvent fraction in the dewetting mixture, the length scale of dewetting increased, because of the faster kinetics of the hole-growth, which limits the number of nucleated holes in the first phase of dewetting. This has provided one additional parameter, other than the initial film thickness, to tune the size of the droplets formed after dewetting. We have also concluded that the dissolution of the polymer in dewetting mixture was found insignificantly small and hence, played no role in the increase in the length scales of the dewetted structures at higher solvent fractions and the faster dewetting kinetics can solely explain the phenomenon.

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which can be further be used as lenses and arrays in optical applications [51], selective placement of catalyst particles [54], multifunctional coatings and patterned surfaces etc.

### **3.4 Conclusions**

It is demonstrated that a low-density uniform OTS SAMs can be formed on glass substrate using vapor phase silane grafting. Time evolution of water contact-angle on these substrates show quick formation of OTS SAMs (nearly 15 minutes) on glass which leads to increasing water contact angle on these substrates. The water contact angle increases with increase of exposure time of OTS at faster rate initially which then plateaued out to give a nearly constant value of 70°. Using these OTS grafted glass substrates for the self-organized dewetting of polystyrene thin films under an optimum mixture of good solvent and water, provides a new method to control the lengthscale of dewetting ( $\lambda$  and  $d$ ). A three-fold reduction in wavelength and two-fold reduction in droplet diameter has been achieved by just varying the extent of OTS grafting on the substrate. This combined with the film thickness variation, and dewetting liquid composition variation provides greater flexibility in the process to fabricate high aspect ratio droplets for various applications.

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coated and dewetted again after first time coat and dewett to get more density of fibers. The density of dewetted droplets cannot be increased in the case of thin films. The  $\lambda/d$  ratio of the dewetted fibers are calculated and its comparison with the Rayleigh-instability model is made.

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# **List of Research publications**

### **Publications from thesis**

- **Priti Yadav**, Ankur Verma, Intensified dewetting of polystyrene thin film under water-solvent mixture: role of solvent composition. Bulletin of Material Science, Volume 45, Issue 1, 2020, 1-5.
- **Priti Yadav**, Nidhi Dubey, Ankur Verma, Controlling Lengthscales in Water-Solvent Induced Self-Organized Dewetting of Thin Polystyrene Films by Modulating the Surface Properties of the Substrate. Journal Of Macromolecular Science, Part B, Volume 61, Issue 7-8, 2022, 914-925.

### **Other publication during PhD work**

- Nidhi Dubey, **Priti Yadav**, Ankur Verma, Sub-micron Structure Formation in Polystyrene Thin Films Assisted by Dewetting in Solvent-Non Solvent Environment: Influence of Non-Solvent Composition. (*Under Review*)

### **Conference/Workshop/ Paper presented**

- Presented research in the form of project titled “Effect of solvent system on the morphology of electrospun polystyrene nanofibers.” in the institute day held at Indian Institute of Technology, BHU during February 16-18, 2018.
- Attended CHEMCON 2019 held at the Indian Institute of Technology, Delhi during 15-19 december 2019.
- Workshop on Research Writing and Publishing held from 26-28<sup>th</sup> September, 2019

at the Teaching Learning Centre, Indian Institute of Technology (BHU), Varanasi.

- Participated in STC on SMART-RTI, Sept. 2017 held during 4-11 September, 2017 in the Mechanical Engineering Department, IIT BHU.