INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: THE EXPERIMENTAL INVESTIGATION ON MICROPATTERNING OF BLENDED AND RANDOM COPOLYMER THIN FILMS

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SHORT ABSTRACT

Micro/nano structures are ubiquitous in nature. These patterns not only exhibit aesthetic appeal but are engineered to perform multiple functions. For example, alternating hydrophobic/hydrophilic domains on the body of *Stenocara* beetles provides excellent mechanism for dew harvesting. Likewise super-hydrophobic property of lotus leaves is due to the presence of hierarchical structures on the surface of leaves. Another example includes, hierarchical structures on butterfly wings responsible for absorbing specific wavelength of light while emitting other, thereby exhibiting exquisite colours. These micro/nano structures found in nature are made up of bio-macromolecules like proteins. Alternately scientists across the globe are inspired to fabricate artificial micro/nano structures using polymers which can be utilize to alter the attributes of the surface. These attributes include wetting behaviour, self-cleaning property, structural colours etc. Numerous methods have been employed to fabricate highly ordered polymeric domains over a surface (direct write lithographic method, soft-lithographic methods and self-assembly based patterning methods etc).

The thesis presented here provides a detailed account of patterning techniques reported by scientists across the globe. Based on the literature survey, an experimental study is undertaken in which pattern generation using phase separation in polymeric bilayer system is explored. Also, the study shows the fabrication of multiscale patterns using synergies of phase separation in polymeric bilayer system, rapid thermal annealing (RTA) and capillary force lithography (CFL).

In other study it is shown that complex pattern can be fabricated using strategic exposure of focussed electron beam on random copolymer films. The random copolymer used contains polystyrene (PS) and poly methyl methacrylate (PMMA) block which are known to exhibit negative and positive tone behaviour under the influence of low electron beam dose. Later, using solvent induced annealing the exposed PMMA blocks undergo dewetting to form nanopatterns at

room temperature. However, at moderate and high e-beam dose PMMA block exhibit the tone reversal behaviour in the exposed region. Moreover, the scattering of electrons in the unexposed area engenders a positive tone behavior to the PMMA blocks. These low molecular weight PMMA chains undergo room temperature dewetting when immersed in solvents. Moreover, Selective removal of PMMA blocks of RCP using suitable solvent provide additional 50% size reduction of the dewetted features.

Thus, the present study provides a generic framework for fabrication of multiscale patterns. The study is also unique in a sense that it opens up a wide range of future possibilities in the area of micro/nano fabrication. Further such explorations can help in the fabrication of a variety of mesoscale patterns with the complex hierarchical arrangement, which has been among many of the real challenges so far.

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