MINIATURIZATION OF PATTERNS
AND
FRICTION AT SOFT INTERFACES

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Certificate

This is to certify that the thesis titled ”**MINIATURIZATION OF PATTERNS AND FRICTION AT SOFT INTERFACES**” being submitted by **Ms Hemalatha Annepu** in the Department of Chemical Engineering, Indian Institute of Technology Delhi, for the degree of **Doctor of Philosophy**, is a record of bona-fide research work carried out by her under my guidance and supervision.In my opinion, the thesis has reached the standards fulfilling the requirements of the regulations relating to the degree.

The results contained in this thesis have not been submitted to any other university or institute for the award of any degree or diploma.

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Abstract

Self-organization method is an excellent alternative to conventional lithographic techniques as the costs involved are significantly less, large areas can be patterned in very short time and importantly, it is the only feasible method for patterning of soft elastomeric films which find usefulness in many important bio-mimicking applications such as super-adhesives etc. Pattern length scales exhibited by soft, thin (thickness less than 10 microns) elastic films cast on the both smooth surfaces and on sharp corrugated surfaces which are in adhesive contact with an external contactor are investigated by means of a linear stability analysis and a non-linear finite element analysis. The pattern instability length scales are found to decrease with increase in the amplitude of the substrate pattern. The smallest wavelengths obtainable from the linear stability analysis are $0.296h$ ('h' is the mean film thickness) with sinusoidally patterned substrates. The non-linear analysis that is done here by means of finite element formulation confirms the results of linear analysis, reiterating the importance of substrate patterning on miniaturization of length scales. This work thus is an important starting point in understanding the role of roughness on the instability length scales, the morphologies of the instabilities formed and the effect of this substrate roughness on the evolution of these instabilities and the debonding forces. The present work at one hand tries to explore ways to improve formation of patterns at smaller and smaller length scales and on the other hand it is aimed to understand the fundamental physics behind phenomena like delamination, that occur in common practice and to develop means to control them.

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