MORPHOLOGICAL COARSENING IN THIN LIQUID FILMS

by

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Certificate

This is to certify that the thesis titled "**MORPHOLOGICAL COARSENING IN THIN LIQUID FILMS**" being submitted by Narendra Kumar Agnihotri in the Department of Chemical Engineering, Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy, is a record of bona-fide research work carried out by him 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

The coarsening dynamics of thermal noise at the free surface of a thin liquid film sandwiched between a solid and a bounding fluid is investigated based on the numerical solution of the 2-D thin film equation under the influence of various disjoining pressures. These fluctuations spontaneously amplify and coarsen to morphologically phase separate into a high curvature drop phase surrounded by a low curvature flat film phase whenever the disjoining pressure is made up of an attractive long range and repulsive short range component. The onset of this Morphological phase separation (**MPS**) is taken to be the appearance of the flat film. The completion of **MPS** is characterized by appearance of flat film at all possible locations in the film. It is seen that coarsening, as denoted by the number of hills and valleys (N) in the pattern, occurs via two distinct stages *viz.*, (1) **Pre-MPS** and (2) **Post-MPS**. An obscure intermediate stage, **MPS** stage, spanning the duration of time between the onset and completion of **MPS** is also identified. While, the exponent in power law dynamics of the type $N \propto t^{\alpha}$, t is time, remains constant ($-1/4$ for $2D$ and $-1/3$ for $3D$) for **pre-MPS** and ($-1/3$ for $2D$ and $-1/2$ for $3D$) for **post-MPS** stage and varies slightly between $-1/10$ to $-1/20$ for later part of the **pre-MPS** stage, it changes from a very high value (~ -2) to a very low value ($\rightarrow 0$) for the **MPS** stage. The **MPS** stage, depending on its exponent, can merge with either of the other two stages and apparently disappear. The rate of coarsening in all three stages depend on the average space avaiable to each hill *viz.,* total domain size divided by total number of hills.

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