RESEARCH OPPORTUNITY IN MATHEMATICAL MODELING AND SCIENTIFIC COMPUTATION: A MULTISCALE VIEW OF CRYSTAL EVOLUTION

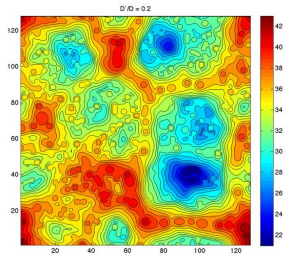
TOPICS AND SCOPE

A central question in materials sciences is: How can atoms cooperate to form functional structures and devices?

In fact, the development of novel optoelectronic devices relies on understanding and controlling the behavior of material systems across several length scales, from the atomistic to the continuum.

In our research group, we investigate, describe and connect phenomena, which span several length and time scales. These phenomena include island nucleation, growth of quantum dots, dewetting of thin films, and other aspects of crystal growth. In this effort, we often draw analogies from other areas such as fluid mechanics and gas dynamics.

Starting from atomistic algorithms and models, we derive mesoscale and continuum PDE-based models that aim to describe the structural evolution of small devices.



Surface morphology via the level-set method
(color indicates height)

METHODS

Asymptotics for PDEs and ODEs
Statistical mechanics and applied probability
Kinetic Monte Carlo simulations
Numerical methods for the solution of ODEs and PDEs

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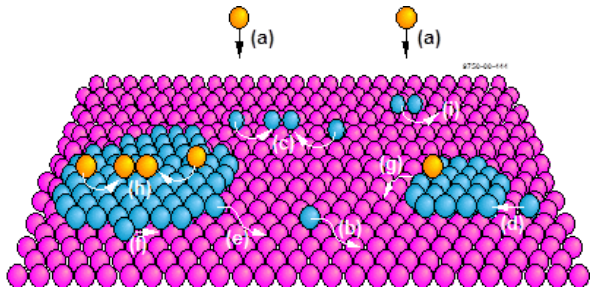

Atomistic processes on a viscinal surface