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Strain induced metastability in the shape evolution of self-assembled nanoislands on Si(111): real-time electron microscopy observations and numerical simulations NIKHIL MEDHEKAR, VIVEK SHENOY, Division of Engineering, Brown University, JAMES HANNON, IBM Research Division, T. J. Watson Research Center — We present real-time Low-Energy Electron Microscopy (LEEM) observations of the growth and equilibrium shapes of (7x7) reconstructed domains on (1x1) reconstructed Si(111) surface which show several intriguing features in its shape evolution due to strain mediated interactions. We find that the shapes of large domains are fundamentally different from the compact shapes of smaller domains. In contrast, large islands show more ramified shapes resembling branched pine-tree when grown at faster rate and connected-triangles morphology when growth is near equilibrium. Using a phase-field model, we show that the key to understanding this behavior is the strain induced metastability of domain shapes that are trapped in the local minima of the complex energy landscape. The consideration of growth shapes that show spontaneous formation of side branches is necessary to establish the presence of unstable orientations and thus, our work shows that in estimating the thermodynamic and kinetic parameters, the conclusions solely drawn based on the analysis of equilibrium shapes can be erroneous.

Nikhil Medhekar
Division of Engineering, Brown University

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