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Self-organization and pattern selection under nanosecond pulsed laser-induced melting of ultrathin metal films[1] RAMKI KALYANARAMAN, CHRISTOPHER FAVAZZA, JUSTIN TRICE, Dept. of Physics, Washington University in St. Louis, RADHAKRISHNA SURESHKUMAR, Energy, Environmental and Chemical Engineering, Washington University in St. Louis — When an ultrathin metal film is rapidly melted by nanosecond (ns) laser pulses, ensuing hydrodynamic instabilities and/or fluid flow due to surface tension gradients lead to self-organizing patterns of ordered nanostructures. The extremely fast heating O(100 K/ns) and resolidification (O(10 K/ns) in such ns melting experiments permits quenching in of the morphology. Thus, multiple pulses of such fast melting/resolidification cycles in the film allow different stages of the patterning process to be identified and studied. We show that pattern formation via a thin film hydrodynamic dewetting instability and thermocapillary flow can compete and the dominating mechanism is one which has shorter time scale. We have explored this behavior for a large variety of metals, including Ti, V, Mn, Fe, Co, Ni, Cu, and Ag. This ns melting approach permits the robust self-organization of a wide variety of nanoscale structures, including nanoholes, nanostars, nanoparticles and nanowires.

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