Size Evolution and Control of Nanostructures in Laser-Directed Atomic Deposition*

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Abstract

A widely observed phenomenon in laser-directed growth of ordered arrays of nanostructures is that the feature size of fabricated nanostructures is much larger than the theoretically predicted value from calculating the atom accumulation due to laser focusing. We examine the diffusion effect on the size broadening by considering two major diffusion processes for deposited atoms, namely terrace diffusion and step-edge descending. A criterion is derived to predict the size evolution of nanostructures, which is a function of terrace diffusion barrier, Ehrlich-Schwoebel step-edge barrier, substrate temperature, deposition flux, and laser properties. Our predicted value of the feature width of aluminum quantum wires is in excellent agreement with the experimental findings. Research to predict the feature size for chromium and other materials is in progress.

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