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Kinetic Transition of Crystal Morphology from Nanoparticles to Dendrites during Electron Beam Induced Deposition of Gold[1] JEUNG HUN PARK, Univ of California Los Angeles and IBM T. J. Watson Research Center, NICHOLAS SCHNEIDER, HAIM BAU, Univ of Pennsylvania, SUNEEL KODAMBAKA, Univ of California Los Angeles, FRANCES ROSS, IBM T. J. Watson Research Center — We studied the kinetic transition from compact nanoparticle to dendritic morphology during electron beam-induced Au deposition using *in situ* liquid cell-based transmission electron microcopy. Radiolysis of water by electrons generates radicals and molecular species. Hydrated electrons and hydrogen and hydroxide radicals can act as reducing agents and initiate the reduction of the water-soluble precursor, $HAuCl_4$, resulting in the precipitation of Au as nanostructures. We tracked nucleation, growth, and morphological transition of Au from movies recorded *in situ*, as a function of irradiated dose and liquid thickness. We identified several distinct regimes that depend on the irradiation time: (1) nucleation; (2) linear volumetric growth; (3) formation of dendritic structures; (4) coalescence and dissolution. A diffusion and reaction model for the radiolytic species and metal ions in the confined geometry of the irradiated volume is used to understand the nucleation sites and morphological transitions. We finally describe how nanoparticles can be made to grow in a stepwise manner by switching the supply of Au ions on and off electrochemically, and discuss possibilities for creating more complex nanostructures.

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