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Morphological evolution of gold nanostructures on an inorganic semiconductor quantum dot array with time-resolved GISAXS

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In optoelectronic devices based on quantum dot arrays, thin nanolayers of gold are preferred as stable metal contacts and for connecting recombination centers. The optimal morphology requirements are uniform arrays with precisely controlled positions and sizes over a large area with long range ordering since this strongly affects device performance. To understand the development of gold layer nanomorphology, the detailed mechanism of structure formation are probed with time-resolved grazing incidence small-angle X-ray scattering (GISAXS) during gold sputter deposition. Gold is sputtered on a CdSe quantum dot array with a characteristic quantum dot spacing of ≈7 nm. In the initial stages of gold nanostructural growth, a preferential deposition of gold on top of quantum dots occurs. Thus, the quantum dots act as nucleation sites for gold growth. In later stages, the gold nanoparticles surrounding the quantum dots undergo a coarsening to form a complete layer comprised of gold-dot clusters. Next, growth proceeds dominantly via vertical growth of gold on these gold-dot clusters to form a gold capping layer. In this capping layer, a shift of the cluster boundaries due to ripening is found. Thus, a templating of gold on a CdSe quantum dot array is feasible at low gold coverage.
N. Paul, E. Metwalli, Y. Yao, M. Schwartzkopf, S. Yu, S. V. Roth, P. Müller-Buschbaum, A. Paul, Nanoscale 7 (2015) 9703-9714.

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