EVOLUTION OF CRYSTALLOGRAPHIC ORIENTATION DURING ANNEALING OF GOLD NANOPARTICLES ON A SUBSTRATE
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Metallic nanoparticles, particularly those for use in catalyzing the growth of one-dimensional nanostructures, are commonly synthesized by a sputtering process. A thin metallic layer is sputtered onto a substrate. With annealing, the sputtered metal separates into a monolayer of catalyst nanoparticles. This crucial first step in the synthesis of nanowires has not been as extensively studied as other aspects. The purpose of this work is to investigate the formation of metallic nanoparticles from a sputtered layer, particularly with regards to the evolution of the crystallographic orientation of the nanoparticles, using a combination of ex- and in-situ X-ray texture analysis. For gold sputtered onto a c-plane Al₂O₃ substrate with Al₀.₅Ga₀.₅N/AlN epitaxial layers to reduce lattice mismatch, the metal first adopts a {111} fiber texture orientation, with rotational disorder in the plane of the substrate, around 300°C. At a higher temperature, around 800°C, the rotational disorder is lost, and the gold nanoparticles assume two fixed orientations with respect to the substrate. The effect of other substrates will also be investigated. This two-step process has implications for the controlled growth of nanowires using metallic catalyst nanoparticles.

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