# TRANSITION FROM THIN GOLD LAYERS TO NANO-ISLANDS ON ITO. INFLUENCE OF THE ANNEALING TEMPERATURE AND THE INITIAL THICKNESS

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Many processes in nanotechnology make use of organized arrays of metallic nanoparticles. In particular, growth of silicon nanowires [1, 2, 3] and carbon nanotubes [4] by the vapour-liquid-solid process is driven by metal droplets, which size and distribution partially control the diameter and density of the wires. Different methods have been investigated to obtain organized nanoparticles on a substrate, like photolithography, self-organization from colloids, patterning by diblock copolymers, etc. Annealing an evaporated thin film is one of the simplest, as long as the requirements on the organization and the size dispersion are not too high.

In this paper, we study the influence of the initial thickness of the metal layer and of the temperature and duration of annealing on the final size and shape of the nano-islands. As the clusters are meant to catalyze the growth of silicon nanowires to be used in hybrid solar cells [5], the substrate is here ITO-coated glass. Gold layers of thicknesses between 1 nm and 4 nm have been evaporated by electron beam and they have been annealed under vacuum at temperatures ranging between 70 °C and 650 °C. SEM pictures clearly show the formation of clusters at the surface, which size and shape heavily depends on the initial thickness of the layers (fig. 1).

Digital image analysis has been used to derive quantitative information and statistics about the number density of the clusters, their size and their geometry. Surprisingly, both the average value and the distribution of the final size of the islands are independent of the temperature for 15-minute long annealing.

From a fundamental point of view, the common explanation of the formation of the islands by the mismatch between the thermal expansion coefficient of the substrate and of the metal layer [6] is thus insufficient if not wrong. Moreover, the evolution is a very fast phenomenon. Two mechanisms remain possible: Ostwald ripening, where large aggregates grow by mass transfer from small ones, and coalescence, where mobile aggregates collide. They differ by their dynamics and by the statistical distribution they induce, which are compared to the experimental results.

From a more applied point of view, the possibility to obtain arrays of metallic nano-clusters with a weak dependence on the temperature opens the way to low-temperature growth of nanowires or nanotubes.

**References:**

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**Figures:**

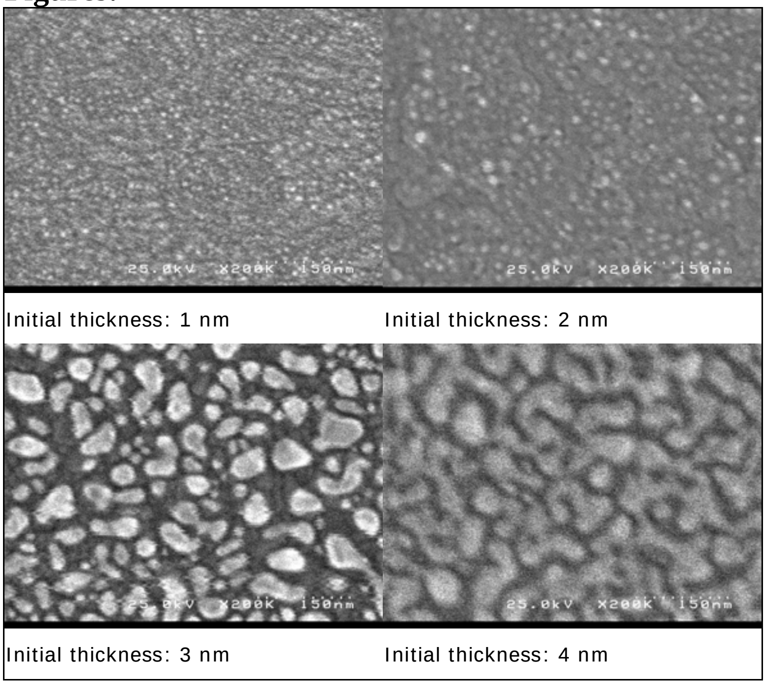


Fig. 1: SEM pictures of gold layers on ITO after annealing at 600 °C