The surface morphology of thin Au films deposited on Si(001) substrates by sputter deposition

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ABSTRACT: Thin (100 nm) gold films were deposited on Si(001) substrates by direct current magnetron sputtering. The effects of the deposition rate, the distance between the target and substrate, the substrate orientation, bias, temperature, and gas flow rate on the surface morphology of the Au film have been studied using atomic-force microscopy. It was observed that the deposition of Au on Si(001) followed the typical Volmer-Weber growth mode characterized, in the initial stages, by hemi-spherical grains distributed uniformly on the surface. Decreasing the target/substrate distance caused both the average grain diameter and height to increase. Decreasing the distance between the target and substrate from 19.5 cm to 5 cm and using a deposition rate of 0.1 Å/s produced samples in the second stages of the VW growth mode characterized by the coalescence of Au islands. Increasing the relative angle from 0° to 90° between the substrate and the substrate table caused the average grain diameter to decrease by approximately 8.7% and the average grain height to increase by approximately 52.3%. Applying a high negative voltage to the substrate during the deposition caused a small decrease of approximately 10.2% in average grain size and a change of 26.2% to the average grain height. When the substrate temperature was lowered during the deposition process from 12 to -11 °C, a decrease of 21.6% was found in the average grain size while the height of the average grain increased by 44.7%. By adjusting the above parameters it was possible to obtain samples with average grain size ranging from 26 to 180 nm with RMS roughness values ranging from 0.8 to 21 nm. The results of this work provides an understanding for how to produce a wide range of surface morphologies of thin Au films on Si(001) for applications such as cantilever sensing and for producing bio-functionalized tips for atomic-force microscopy.

ALL ARE WELCOME!!!