# Morphology and structure of electrochemically deposited Au on miscut Si(111)-H

S Warren, T-L Lee, BCC Cowie, J Zegenhagen
ESRF, Av Jules Horowitz, BP-220, F-38043 Grenoble FRANCE

F Maroun, P Allongue
CNRS UPR 15, Physique des Liquides et Electrochimie, Université Pierre et Marie Curie, Tour 22, 4 Place Jussieu, 75005 Paris, France

Electrochemical deposition allows the creation of thin films or nanostructures with novel morphologies not accessible by other growth techniques. Synchrotron radiation based measurements such as Surface X-ray diffraction, or X-ray standing waves are ideally suited for monitoring the growth mode of these deposits, even at very low coverages.

Strikingly different morphologies of Au deposits on miscut Si have been obtained by varying the electrochemical parameters such as the deposition potential or electrolyte. A comparison of these deposits has been made using Surface X-ray diffraction (SXRD) and X-ray standing waves (XSW).

The miscut Si(111)-H substrate offers the possibility of depositing Au islands solely at the step-edges (Fig 1), representing a potentially elegant method of nanowire formation on semiconductor surfaces. SXRD has been used to identify the structure of the Au islands themselves, their arrangement relative to the hexagonal Si(111) surface (Fig 2), and the effect of the steps on the Au island morphology. The effect of the deposition potential on the island density, epitaxy and alignment has also been investigated.

Contiguous 2-D layers of Au may also be deposited on Si(111)-H by changing the electrolyte and deposition parameters. The structure of these films has also been investigated, and in contrast with the island growth mode described above, films of uniform, well-defined thickness are formed (Fig 3). These films may be used in the future as ‘buffer layers’ for further metal growth.

Comparisons of the structure of the deposits allows us to better understand the growth mode of Au on Si(111)-H surfaces, and will ultimately allow ‘tuning’ of the structure of the islands or films by careful adjustment of the electrochemical parameters.

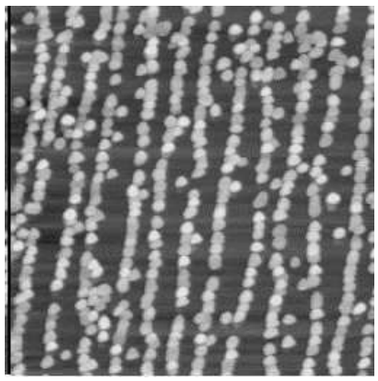

Figure 1. Ex-situ AFM image of potential controlled Au ‘island’ deposition on 0.2º miscut Si(111)-H

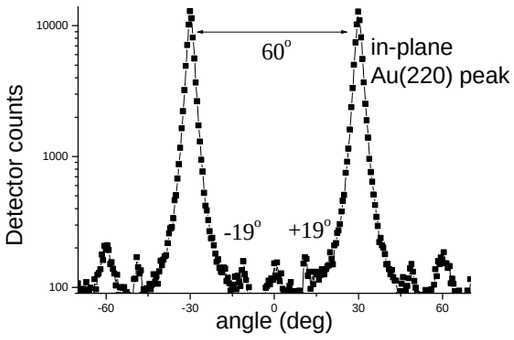


Figure 2. In-plane alignment of the islands (for a medium island density sample of ~20ML Au), with respect to the hexagonal Si(111)-H surface

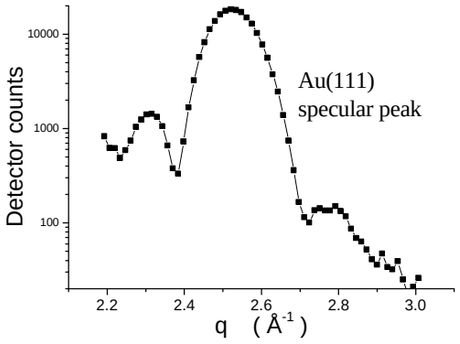


Figure 3. Specular scan of Au(111) peak for a ‘flat’ sample of ~5 ML. The oscillations either side of the main peak indicate a uniform film thickness, and the Au(111) crystal planes are aligned with the substrate Si(111) planes