MM 41: Topical Session Growth Kinetics II

Time: Wednesday 17:15–18:15 Location: H4

MM 41.1 Wed 17:15 H4

Photoemission Electron Microscopy of the Temperature Dependent Pre-nucleation Dynamics of Sexiphenyl Molecules Deposited on Cu (110) — A J Fleming, F P Netzer, and •M G Ramsey — Surface and Interface Physics, Karl-Franzens Universität Graz, Universitätsplatz 5, 8010 Graz, Austria

The pre-nucleation dynamics of sexiphenyl (6P) molecules deposited in-situ on Cu (110) are investigated by photoemission electron microscopy (PEEM) in ultrahigh vacuum. PEEM, in threshold mode, is used to monitor precisely in real-time a) the amount deposited, b) layer filling by 6P molecules, c) dynamic surface density redistributions during layer filling and d) critical surface density spontaneously induced meta-stable layer de-wetting. It is by studying this crucial pre-nucleation deposition period that the requirements for critical nucleation of 6P, such as substrate commensurability, can be understood. A numerical simulation of PEEM image photoemission intensity variations with time is shown to help determine pre-nucleation layer filling mechanisms for various growth temperatures. Comparison with data previously obtained from static techniques, such as STM and NEXAFS, together with dynamic data from PEEM of 6P deposited on Cu (110) 2 x 1 * O [1] enable the 6P nucleation processes to be elucidated from PEEM.

[1] A J Fleming et al, J. Phys: Condens. Matter 21 (2009) 445003

MM 41.2 Wed 17:30 H4

Sub-monolayer growth investigations of para-sexiphenyl on sputter-modified mica(001) and SiO2 — •Stefan Lorbek[1], Gregor Hlawacek[1], Thomas Potocar[2], Adolf Winkler[2], and Christian Teichert[1] — [1]Institute of Physics, University of Leoben, 8700 Leoben, Austria — [2]Institute of Solid State Physics, Graz University of Technology, 8010 Graz, Austria

Although progress has been made in recent years in the understanding of fundamental growth processes in organic molecular beam epitaxy, the underlying details are still to be explored [1]. Especially, understanding of the island nucleation on the substrate during the deposition of oligomere thin films is crucial for the design of growth routes that will avoid the undesired formation of 3D structures. Here, sub-monolayers of the rod like model molecule para-sexiphenyl (6P) have been deposited onto the isotropic surfaces of SiO2 and pre-ion bombarded mica(001) under ultra-high vacuum resulting in almost upright standing molecules. The film morphology was recorded by ex-situ atomic force microscopy. For the determination of the critical island size i*, films were grown as a function of coverage, surface temperature and evaporation rate. Three different methods were applied to determine i*: (a) Rate theory [2], scaling theory [3] and (c) capture zone scaling using Voronoi tessellation [4]. Funded by FWF(Austria).

[1] G. Hlawacek,et al., Science 321, 108 (2008) [2] J.A. Venables et al., Rep. Progr. Phys.47(1984)399. [3] J.G. Amar,F. Family, Phys. Rev. Lett.74(1995)2006. [4] A. Pimpinelli,T.L. Einstein, Phys.Rev.Lett.99(2007) 226102

MM 41.3 Wed 17:45 H4

Grain growth under limited junction mobility — •Dana Zöllner and Peter Streitenberger — Otto-von-Guericke-Universität Magdeburg, Institut für Experimentelle Physik, Postfach 4120, 39016 Magdeburg, Germany

Recently it has been demonstrated by experimental, theoretical and molecular dynamics simulation studies that triple lines and quadruple points of a three dimensional grain network may have finite mobilities different from the adjoining grain boundaries. Hence the kinetics of grain growth at very small grain sizes can depend also on the mobility of these boundary junctions.

We model nanocrystalline grain growth in polycrystals under the assumption that the mobility of grain boundaries is limited at small grain sizes. The standard Monte Carlo Potts model is modified by assigning each grain feature - grain boundary interface, triple line and quadruple point - its own specific mobility. For initially very small grains it can be observed that a reduction of the triple junction and quadruple point mobility leads to a change of the growth kinetics of a 3D grain network from parabolic to linear and exponential growth. These changes in the growth behaviour of the mean grain size are associated with changes in the grain size distribution. Due to the larger number of small grains the size distribution is shifted to smaller relative grain sizes. Additionally, new analytic grain size distribution functions have been calculated for the junction limited growth regimes, which are in excellent agreement with the simulation results.

MM 41.4 Wed 18:00 H4

Local grain growth kinetics in Al-Mg studied by 3DXRD microscopy — •Carl E. Krill III[1], Søren Schmidt[2], and Carsten Gundlach[3] — [1]Institute of Micro and Nanomaterials, Ulm University, Ulm, Germany — [2]Risø DTU, Roskilde, Denmark — [3]MAX-lab, Lund University, Lund, Sweden

With the recent extension of the Mullins-von Neumann relation to 3D by MacPherson and Srolovitz comes new impetus for measuring the local kinetics of grain growth in real polycrystalline specimens. Thanks to three-dimensional x-ray diffraction microscopy (3DXRD), it is now possible to map the 3D microstructure of a single-phase polycrystalline material nondestructively, which opens up an exciting new avenue for the *in situ* study of grain growth. In this contribution, we report the microstructural characterization of hundreds of contiguous grains in a polycrystalline specimen of Al-1wt.% Mg before and after an anneal at 350°C. By measuring the displacement of individual grain boundaries, we are able to assess the local kinetics of growth (and shrinkage) for a statistically significant number of grains—information that can then be compared to the predictions of analytic models for the evolution of local and statistically averaged microstructural parameters. Exploiting the volumetric nature of the grain-boundary mapping that is delivered by 3DXRD, we conduct a direct experimental test of the extent to which the Al-Mg sample microstructure evolves as predicted by a phase-field model for grain growth under the assumption of isotropic boundary mobilities and energies.