MM 47: Topical Session Growth Kinetics III

Time: Thursday 10:15–11:30 Location: H4

Topical Talk MM 47.1 Thu 10:15 H4

Selecting a single orientation for millimeter sized graphene sheets — •Raoul van Gastel[1], Alpha T. N'Diaye[2], Dirk Wall[3], Johann Coraux[4], Carsten Busse[2], Niemma M. Buckanie[3], Frank-J. Meyer zu Heringdorf[3], Michael Horn von Hoegen[3], Thomas Michely[2], and Bene Poelsema[1] — [1]University of Twente, Enschede, The Netherlands — [2]Universität zu Köln, Köln, Germany — [3]Universität Duisburg-Essen, Duisburg, Germany — [4]Institut Néel/CNRS, Grenoble, France

We have used Low Energy Electron Microscopy (LEEM) and Photo Emission Electron Microscopy (PEEM) to study and improve the quality of graphene films grown on Ir(111) using CVD. CVD at elevated temperature already yields graphene sheets that are uniform and of monatomic thickness. Besides domains that are aligned with respect to the substrate, other rotational variants grow. Cyclic growth/etching, exploiting the faster growth and etch rates of the rotational variants, yields films that are > 99 % composed of aligned domains. Precovering the substrate with a high density of graphene nuclei prior to CVD yields pure films of aligned domains extending over millimeters. Upon cooling, branched line defects develop in the graphene films which are grown at high temperature. We demonstrate that these defects are wrinkles in the graphene layer, i.e. stripes of partially delaminated graphene that may ultimately provide anchor points for lift-off techniques. With LEEM we observe the reversible appearance and disappearance of the wrinkles and also observe strain relaxation to take place simultaneously with the formation of a wrinkle.

MM 47.2 Thu 10:45 H4

Growth, stability and decay of cluster superlattices on the Ir(111)/graphene moiré — •Timm Gerber[1], Alpha T. N'Diaye[1], Carsten Busse[1], Josef Mysliveček[2], and Thomas Michely[1] — [1]II. Physikalisches Institut, Universität zu Köln — [2]Charles University, Praha

The moiré pattern of graphene on Ir(111) is a versatile template for the growth of two-dimensional cluster superlattices through vapour phase deposition. Using a simple growth model and kinetic Monte Carlo simulations we find that Ir cluster superlattice formation at 350 K involves the mobility of Ir momomers and Ir dimers between different moiré unit cells. Ir clusters are epitaxial, with the (111) cluster plane aligned to the (111) substrate plane and the $[1\bar{1}0]$ cluster direction aligned with the $[1\bar{1}0]$ substrate direction. In dependence of the cluster size, upon heating cluster superlattices decay through two processes: (i) complete cluster coalescence through the migration of a cluster to a neighbouring occupied moiré unit cell, where the two clusters involved reshape to a new cluster within a single moiré unit cell; (ii) incomplete cluster coalescence or cluster sintering through two clusters fluctuating in position coming into contact. Though also in cluster sintering the clusters reshape, the new sintered cluster occupies two moiré unit cells. The decay of cluster superlattices is quantitatively modelled and estimates for activation energies are obtained. Surprisingly, for all growth and decay processes modelled, we obtain extremely low prefactors. Upon heating the height distribution of clusters may improve and reshaping of single clusters without coalescence or intercell motion is observed.

MM 47.3 Thu 11:00 H4

Organic semiconductor growth on Graphene studied by LEEM and μLEED — •Gregor Hlawacek[1,2], Fawad S. Khokhar[2], Raoul van Gastel[2], Bene Poelsema[2], and Christian Teichert[1] — [1]Institute of Physics, University of Leoben, 8700 Leoben, Austria — [2]MESA+ Institute for Nanotechnology, University of Twente, NL-7500AE, Enschede, The Netherlands

The organic semiconductor para-sexiphenyl (6P) was deposited at various substrate temperatures onto graphene flakes grown on Iridium (111). The dynamics of the deposition process and the crystallographic structure were observed in-situ by means of Low Energy Electron Microscopy (LEEM) and micro Low Energy Electron Diffraction (μLEED). Layer-by-layer growth of lying molecules on graphene is observed for low deposition temperatures. After formation of a low-density layer, the full first monolayer already shows a bulk like structure. An exceptionally high mobility for 6P on graphene is observed in the initial low density layer. For room temperature the growth mode changes to Stranski-Krastanov for 6P on graphene. At elevated temperatures a continuous layer of upright standing molecules on the Ir(111) surface is nucleated by the presence of the graphene flakes.

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MM 47.4 Thu 11:15 H4

Smoothening at the organic-organic heterostructure interface — •Alexander Hinderhofer[1], Stefan Kowarik[1,2], Alexander Gerlach[1], Frank Schreiber[1], and Federico Zontone[3] — [1]Institut für Angewandte Physik, Universität Tübingen, Auf der Morgenstelle 10, 72076 Tübingen, Germany — [2]Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720, USA — [3]ESRF, 6 Rue Jules Horowitz, BP 220, 38043 Grenoble, France

In situ real-time x-ray reflectivity and complementary atomic force microscopy are used to monitor crystallinity and roughness evolution during growth of thermally evaporated organic heterostructures, using perfluoropentacene (PFP) on diindenoperylene (DIP) and pentacene (PEN) on PFP. Surface smoothening during evaporation of the second material on top of the first is observed for both systems. The smoothening mechanism can be rationalized by a lowered step edge barrier, as compared to homoepitaxy, i.e. the step edge barrier for certain molecules (PFP, PEN) is very low for diffusion on a molecular crystal of a different species (DIP, PFP). In addition, we find an exceptionally well-ordered interface for PEN-on-PFP growth and PEN growth with very low roughening. A heterostructure of these materials scatters x-rays coherently over the entire thickness.

Material combinations such as those presented here may be used as model cases for organic-organic interface engineering.