

**SURFACE X-RAY DIFFRACTION STUDY OF Cu UPD ON Au(111) ELECTRODE IN 0.5M H<sub>2</sub>SO<sub>4</sub> SOLUTION**

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The structure of UPD copper, a hydration water molecule, and a bisulfate anion on Au(111) surface in 0.5M H<sub>2</sub>SO<sub>4</sub> solution has been determined by *in-situ* surface X-ray diffraction study. The X-ray data collection was carried out at the synchrotron facility of SPring8 at beam line 09XU. The bisulfate anion and the UPD copper form a  $\sqrt{3}\times\sqrt{3}$  structure on an Au(111) electrode at a potential between 250 and 400 mV. At this potential range, UPD Cu, a bisulfate anion, and a hydration water molecule coadsorb on Au(111), while the coverages of copper and bisulfate anion are 2/3 and 1/3, respectively. The co-adsorption structure is represented by the symmetry of *P31m*. Bisulfate anion forms *C3v* symmetry and is accommodated in a copper honeycomb center on Au(111) surface. On top of each copper atom, a hydration water molecule is accommodated to form a stable and closest-packed water coplanar adlayer with a large density. The distance (OH...O), 2.88 Å, is typical of the hydrogen-bonding value seen in an ice structure under high pressure. The new water phase is formed by a closest packed oxygen of 1x1 with a coplanar layer. At a more positive potential than 940 mV, the bisulfate anion forms a  $\sqrt{3}\times\sqrt{3}$  structure on a copper free Au(111) surface, while at a more negative potential than 250 mV, the  $\sqrt{3}\times\sqrt{3}$  structure is retained on 1x1 Cu/Au(111) surface.

**Keywords: ELECTRODE SURFACE UNDERPOTENTIAL DEPOSITION HYDRATION**

**KINEMATICAL X-RAY SCATTERING THEORY OF SELF-ASSEMBLED QUANTUM DOT ARRAYS AND SUPERLATTICES**

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Self-assembled quantum dots (SADs) are the subject of intense investigation as they offer carrier confinement in all three dimensions, an important feature for various applications, particularly in optoelectronics. The fact that the optoelectronic properties of the SADs strongly depend on the shape and size distribution of the dots as well as on interface mixing and, in the case of Stranski-Krastanow growth, on the properties of the wetting layer (WL) motivates the development of non-destructive characterization techniques. We have recently observed that InAs SAD arrays embedded in InP(001) under various growth conditions can yield essentially identical high-resolution x-ray diffraction (HRXRD) scans near Bragg reflections while their x-ray reflectivity (XRR) signatures are markedly different. However, standard roughness models in XRR calculations are incompatible with well-separated SADs embedded in a matrix. A kinematical x-ray scattering model incorporating the effects of the dot shape, strain-state, spatial distribution, WL thickness and x-ray coherence length on the scattering signal will be presented. Each parameter yields a different signature in the reciprocal space. In particular, we show how the variation of the incident beam coherence length, through the use of different monochromator systems, allows to control the volume for coherent scattering and thus to determine the SADs spatial distribution. Furthermore, our model indicates that it is possible to determine the quantum dots height and the wetting layer thickness independently from a combination of specular and non-specular scans along the reciprocal direction perpendicular to the sample surface.

**Keywords: SELF ASSEMBLED QUANTUM DOTS, X RAY DIFFRACTION, X RAY REFLECTIVITY**

**SURFACE GLASS TRANSITION OF POLYSTYRENE BY X-RAY REFLECTIVITY MEASUREMENTS**

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By using X-ray reflectivity (XR) as well as X-ray diffuse reflectivity (XDR), we investigated structure and morphology of polystyrene (PS) surfaces near the bulk glass transition temperature  $T_g$ . A flat PS surface was obtained as follows: (1) a lump of melted PS ( $M_w = 310000$ ,  $T_g = 370K$ ) was dropped onto a polished silicon wafer; (2) annealed up to 450K for 6 hours and quenched to the room temperature; (3) the PS of which dimension was 20mm\*20mm\*2mm was peeled from the silicon wafer. XR revealed the PS at room temperature had a fairly flat surface with the rms roughness of 1 nm. XDR showed the non-fractal height-height surface correlation; it appeared that this surface was formed after condensation of capillary wave fluctuations. The sample studied showed  $T_g$  at the surface 50K lower than that of the bulk. XR changed drastically with the heating process indicating the considerable variation in electron density at the surface, although the scattering from the bulk PS showed no variation. For PS fully placed at room temperature for a long time (more than 14 days) did not show such variation described above. Present results will be discussed on a standpoint of conformation of polymers and the decrease in the viscosity at the polymer surface will be compared with the surface-melting observed at crystal surfaces.

**Keywords: SURFACE GLASS TRANSITION X-RAY REFLECTIVITY POLYSTYRENE**

**STRUCTURAL CHARACTERIZATION OF DIGLYCOL CARBONATE AND POLYCARBONATE SOLID STATE NUCLEAR TRACK DETECTORS IRRADIATED WITH INFRARED LASER PULSES**

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Samples of solid-state nuclear track detectors (SSNTDs) CR-39 diglycol carbonate and Makrofol polycarbonate polymers were exposed to infrared laser pulses with different exposure doses ranging from 0.0 to 7.5 J/cm<sup>2</sup>. The development of the noncrystalline phase in the semicrystalline polymers and the effect of laser pulses on the degree of ordering in these two polymers were investigated through x-ray scattering and infrared region spectra studies. The results indicate that similar changes in short range order take place in both polymers upon laser irradiation. The noncrystalline phase content in the two detectors increases on increasing the laser dose up to 1.5 J/cm<sup>2</sup> and then decreases when increasing laser dose up to 7.5 J/cm<sup>2</sup>. Infrared absorbance measurements show that different deformation in molecular microstructure takes place in the two polymers when exposed to laser irradiation and that Makrofol polycarbonate polymer may be used as a sensor for infrared laser irradiation.

**Keywords: NUCLEAR TRACK DETECTORS**