

Report experiment SI-816

Information on C₆₀ interacting with Si(100) substrate was obtained by Surface X-ray diffraction (SXR) at ID03. We studied the C₆₀ molecules adsorbed on Si(100)-2x1 deposited at room temperature (RT) and after different annealing treatments from 700K to 1100 K. In particular, we focused on the mechanism of cage and local substrate deformations induced on the substrate by heating, up to the fullerene decomposition and SiC islands formation.

During the measurements we recorded intensities of the Si(100) Crystal Truncation Rods (CTR) and of the fractional order rods corresponding to the 2x1 reconstruction. Surface cleanliness and C₆₀ calibration were verified by Auger spectroscopy. As expected no new reconstructions have appeared during and after C₆₀ deposition and thermal treatment.

During the RT deposition, the SXR analysis reveals the existence of the Si surface reconstruction fractional peaks. The intensity of the fractional order peaks slowly decreased as the deposition proceeds because of the absorption of the C₆₀ overlayers but it never disappears. This behaviour indicates that the underlying Si substrate reconstruction is not heavily affected by the fullerene deposition at RT. It is only during the thermal treatment that fractional order rods intensities vanish.

The fractional peaks disappear only after annealing at 700 K. The analysis of SXR measurements show that the thermal treatment induce an increased roughness with C atoms diffusing into the first two surface layers. The Crystal truncation rods have been measured after thermal treatment of the C₆₀/Si(100) system at temperatures of 700, 920, 1050 and 1100 K. The CTR intensity is reduced indicating a strong deviation of the system morphology from the surface order caused by annealing. For heating at temperature of 920 K the surface is completely destroyed and the morphological disorder involves several layers (>100 nm), while at 1050 K there is a further increasing of morphological disorder. A further thermal treatment at T=1100 K reverses the roughness to the value obtained at 920 K annealing temperature and diffraction peaks of SiC are detectable.

This work has been performed during the PhD thesis of Souad Bakari (XVII cycle anno 2005 of Italian PhD in Physics at the Università di Modena e Reggio Emilia). The publication preparation of this results is in progress.