Growth and properties of ultra-thin PTCDI–C_8 layers on Si and GaN surfaces

Electronic and physicochemical properties of molecular films on semiconducting substrates depend on growth mechanism and film morphology. Studies on evolution of the interface formation with increasing coverage are particularly needful in order of better understanding the mechanisms that control final properties of the film.

This thesis presents the results obtained by using X-Ray Photoelectron Spectroscopy (XPS), Ultraviolet Photoelectron Spectroscopy (UPS), Scanning Tunneling Microscopy (STM) and Density Functional Theory calculations (DFT) for adsorption studies of PTCDI–C_8 molecules on the selected semiconductors surfaces: p–Si(100), n–Si(110), p–GaN(0001), n–GaN(0001). The aim was to characterize impact of the substrates on the morphological, structural and electronic properties of the organic layers, in particular the role of the substrate as a template determining of the molecular film structure.

PTCDI–C_8 molecules relatively easily arrange into supramolecular architectures by means of the hydrogen bonds and π-π-stacking. For both silicon surfaces it was found, that self-organization of the molecules is limited by a strong molecule–substrate interactions. As a consequence, the layer is amorphous. The exception were molecular chains observed on Si(110) surface at the 0.5 ML coverage. On the contrary, on gallium nitride, formation of highly–ordered multi–layered islands is the result of intermolecular interactions. Spectroscopic measurements was performed at the various stages of growth. The results obtained for all systems show significant changes in the electronic structure and chemical states of the interfaces, in particular for the n–type substrates.

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