

Optical properties of the interfaces in organic/organic multilayered heterostructures

O.D. Gordan, S. Hermann, M. Friedrich and D.R.T. Zahn

Institut für Physik, Technische Universität Chemnitz, 09107 Chemnitz, Germany

Abstract

The optical response of the organic superstructures consisting of alternative layers of 3,4,9,10-perylenetetracarboxylic dianhydride (PTCDA)/copper phthalocyanine (CuPc) and tris-(8-hydroxyquinoline)-aluminum(III) (Alq₃)/N,N'-Di-[(1-naphthyl)-N,N'-diphenyl]-(1,1'-biphenyl)-4,4'-diamine (α -NPD) is compared. The optical response of the multilayer is influenced by the optical properties of each individual layer and also by optical interferences. As a result the optical properties of the superstructure can be tuned within a large range using different layer thicknesses and different periods. The superstructures were prepared by organic molecular beam deposition (OMBD) in high vacuum (HV) on hydrogen passivated, (111) oriented silicon. The substrates were kept at room temperature during the deposition. The optical response of the superstructure was investigated by means of spectroscopic ellipsometry in spectral range of 0.73-5 eV. While for PTCDA and CuPc the molecular interaction gives rise to strong anisotropic crystalline layers the amorphous growth of Alq₃ and α -NPD results in isotropic layers. Taking into account the dielectric function of the single layers the optical response of the Alq₃/ α -NPD superstructure can be modeled assuming sharp optical interfaces. However, for the PTCDA/CuPc superstructure the optical response requires a more sophisticated approach than simply superimposing the responses of the individual layers. The deviation between simulated and experimental data is assigned to the electronic interaction at the interfaces between the π -orbitals of PCDA and CuPc.