OPTICAL ANISOTROPY OF CuPc FILMS GROWN ON GaAs(001) OXIDIZED SURFACES

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Organic molecular semiconductors metalphtalocyanines (MPc) are known to be very prospective for application in electronic, light and photovoltaic devices. Efficiency of these devices considerably depends on the film structure, which, in turn, depends on the substrate nature.

Using RA spectroscopy we studied CuPc thin films grown at the same conditions on oxidized (001) surfaces of GaAs substrates with different doping types. We found the coincidence between orientation of the film anisotropy axes and principal substrate axes [1]. This indicates that the oxidized GaAs surface produces an orienting effect on CuPc molecules. The experiment revealed essential differences in structure and optical anisotropy for the films grown on n- and p- doped substrates. The highest scale of optical anisotropy was observed for the film grown on the n-doped substrate. Such film also reveals structural anisotropy, presented in Fig.1a, where an ordered ensemble of CuPc crystallites some of which form chains aligned in the same direction is shown.

Since the chemical composition and the structure of the initial oxidized surfaces were identical, the observed differences in the structure and optical anisotropy of the grown CuPc films can be exclusively due to different sign or/and distribution of the discrete electric charges at the initial surfaces induced by the Fermi level pinning. Static electric field of the charges affects CuPc molecules near the surface, forcing them to orient in a certain way. The calculations performed show that only the interface charged defects elongated in the $\left[1\bar{1}0\right]$ direction produce the found orienting effect. Such defects can form in a layer of excess As at n-GaAs(001)/oxide interface [2].

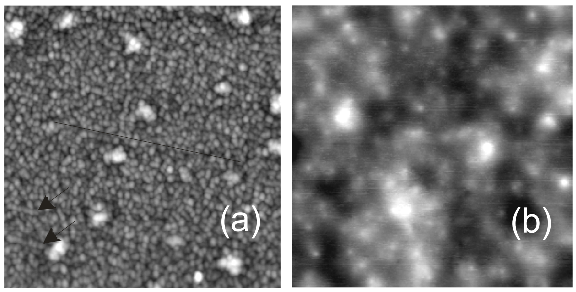

Fig. 1. AFM (4x4) μm^2 images of CuPc films grown on oxidized (001) surface of n- $2\cdot10^{18}cm^{-3}$ - (a), and p-$2\cdot10^{18}cm^{-3}$- (b) doped GaAs wafers.

We have also studied modifications of RA spectra of the CuPc films grown on GaAs(001) as a function of film thickness [1]. To explain the observed modifications, we have calculated the RA spectra assuming that all the molecules in the film have the same orientation. The found qualitative agreement between the calculated and the experimental curves allows us to conclude that there is no rotation of the molecules in films up to thickness of 60 nm.

Keywords: organic films; optical anisotropy; structure

References

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