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Magnetic field influence on the molecular alignment of vanadyl phthalocyanine thin films

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Abstract

Thin vanadyl phthalocyanine (VOPc) films with thicknesses ranging between 10 and 100 nm were grown by organic molecular beam deposition (OMBD) in high vacuum on H–Si(1 1 1) and quartz substrates. The influence of a magnetic field (1.3 T) applied during the film growth was investigated by means of variable angle spectroscopic ellipsometry (VASE), Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction and atomic force microscopy (AFM). The dielectric function was determined by means of VASE. The VOPc layers were found to be uniaxially anisotropic, i.e. exhibit the same optical constants along two of the Cartesian axes, and different optical constants along the third axis. The values of the dielectric function with in-plane of the substrate are larger compared to those out-of-plane. The in-plane and out-of-plane values of the imaginary part of the dielectric function in the region of the Q-band were used to determine the tilt angle of the molecular plane with respect to the substrate plane. Films deposited without magnetic field have the molecular planes tilted with respect to the substrate plane by about 24°, while those deposited in a magnetic field perpendicular to the substrate, the molecules tend to align their molecular planes with respect to the substrate at ca. 3°. All the samples were found to have a triclinic crystallographic structure. From the comparison between the FTIR spectra of VOPc layers and pellets dispersed in KBr, it can be also deduced that the molecules are lying parallel to the substrate in the case of samples grown in the presence of a magnetic field and slightly tilted in those grown without magnetic field.

Keywords: A1. Crystal structure; A1. Fourier transform infrared spectroscopy; A1. Spectroscopic ellipsometry; A2. Magnetic field-assisted molecular growth; B1. Vanadyl phthalocyanine (VOPc); B2. Organic molecular semiconductors

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