Optical Characterization of Plasma-Deposited SiO2-like Layers on Anisotropic Polymeric Substrates

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8:00am AS+EM+MS+TF-TuM1 Optical Characterization of Plasma-Deposited SiO2-like Layers on Anisotropic Polymeric Substrates, G. Aresta, Eindhoven Univ. of Tech., The Netherlands, A.P. Prensboom, Materials Innovation Inst. (M2i), The Netherlands, S.A. Starostin, Eindhoven Univ. of Tech., The Netherlands, H. de Vries, FUIFILM Mfg Europe B.V., The Netherlands, M.C.M. van de Sanden, M. Creatore, Eindhoven Univ. of Tech., The Netherlands

Amongst the most common thin film characterization tools, spectroscopic ellipsometry (SE) is increasingly used to determine the layer optical properties. Such characterization is still a challenge when optical anisotropy is present either in the film or in the substrate. The study of thin films deposited on polymeric substrates is an example because polymers often show optical anisotropy. In this contribution the optical characterization of polyethylene 2,6-naphtalate (PEN) in its transparent region is carried out by means of Transmission Generalized Ellipsometry (TGE) and reflection multi-angle spectroscopic ellipsometry (SE). TGE measurements determine the in-plane and out-of-plane anisotropy and orientation of the material index ellipsoid, with respect to the laboratory frame. Reflection multi-angle SE measurements are performed to determine the absolute refractive index values along the x, y and z directions (i.e. the laboratory frame). The full optical characterization of PEN substrates has been carried out first by identifying its in plane anisotropy (i.e. $\Delta n_x = n_x - n_y$) and in-plane orientation of the material index ellipsoid with respect to the x axis, by means of TGE measurements at 0° angle of incidence. A second step consisting of TGE measurements at different angles of incidence has allowed the determination of the out-of-plane anisotropy (i.e. $\Delta n_z = n_z - n_x$) and the material index ellipsoid out-of-plane orientation with respect to the z axis. Finally, reflection multi angle measurements have allowed the determination of the optical dispersions along the three axes (x, y, z). The values of the refractive index calculated at 633 nm are $n_x = 1.74$, $n_y = 1.75$ and $n_z = 1.52$. This characterization is functional to the determination of the refractive index of plasma-deposited SiO2-like layers deposited on PEN substrates. The SiO2-like samples have been deposited in Atmospheric Pressure Glow discharges [1,2] from Ar/O2/hexanehexylidilsoxane mixtures at different duty cycles. SE measurements have been performed in ambient air and in vacuum: an increase of the refractive index values with the duty cycle has been observed, attributed, on the basis of complementary diagnostics, to an increase in film density with the duty cycle.

References: