Abstract

Spectroscopic ellipsometry (SE) and AFM are powerful tools for the characterization of planar structures in the nanometer regime. SE is on top compatible with most industrial production lines and allows an in-situ (on-line) monitoring of the production steps during the manufacturing process. Although it is experimentally well known, that SE delivers very sensitive fingerprints of the investigated rough surface structures, it is very difficult to decode the data and directly determine the responsible structure. An even more difficult task is to obtain the optical properties of the material by fitting the SE data to a surface morphology model.

In this work we implement the theory of Vlieger and Bedeaux regarding surface morphology and its effects on the optical response of the surface. According to this theory any type of surface perturbation can be described by so-called electromagnetic excess fields. All the Fresnel coefficients are given in terms of the integrated excess fields perpendicular to the surface. Our study was restricted to calculations regarding ellipsometry measurments and the use of roughness parameters estimated by AFM information. Allthough the theory provides a way to treat specific roughness morphologies, considering the complexivity induced by the anisotropy of the samples we were interested in, we restricted ourselves to the more general treatment by a roughness model of a Gaussian hight-hight correlation function.

Before dealing with the anisotropic samples we performed a theoretical study of the effect of surface roughness on the determination of the dielectric properties by ellipsometric measurements according to the theory of Vlieger and Bedeaux, on an isotropic surface, such as c-Si. The shape of the curvatures were compared to that of the theory of Ohlidal and Lukes from an earlier work of S.Logothetidis[18].

Since our interest was focused on flexible anisotropic materials, such as poly(ethylene terephthalate) (PET) and poly(ethylene naphtalate) (PEN), an attempt was made to generalize the theory results to include some special cases of anisotropy. SE data of PET and PEN were used to obtain their optical properties by fitting them to a surface roughness model. To achieve this, appropriate software had to be developed. The data were approximated by considering uniaxial anisotropy with the optical axis parallel to its surface. The estimation of the roughness was obtained from AFM measurements. We tried to obtain the actual optical properties of the specific materials. Allthough we could not at this point find a measurable difference between the pseudodielectric and the actual dielectric properties, it seems as if a more thorough investigation and persisting attempts in this direction could reveal information about surface morphology and lead to results with worthy practical use.