Accurate measurements of thin films parameters using a novel SPR system

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Abstract

We introduce a novel common-path SPR system for simultaneous, high signal-to-noise ratio reflectivity and phase angle resolved assays. By measuring solutions with known refractive indexes with this system and fitting the reflectivity and SPR phase curves with the transfer matrix, we can determine the characteristics of the SPR sensor chips (refractive index and thickness of Ti and Au thin films) with a high degree of accuracy. The system is based on a proprietary SPR technology developed by ICB[1] and on a common-path interference scheme. By introducing a beam displacer and setting the analyzer at 45°, we can obtain the reflectivity and phase curves simultaneously. The waveplate is used for adjusting the ratio between the P and S polarized light, in order to increase the fringes contrast. To find the correspondence between each pixel of the camera and the angle of incidence, SPR measurements were performed on a BK7 glass surface using four glycerol solutions of different concentrations with known refractive indexes (also measured with a refractometer). For each reflectivity curve, the pixel corresponding to the critical angle is determined. Then, a polynomial fit of the curve pixel versus the critical angle is performed, and the correspondence between the pixel and the angle of incidence is derived. With the calculated angles of incidence, the reflectivity and phase curves were fitted using the transfer matrix method and the SPR sensor chip parameters were derived, being in agreement with reported values[2][3]. By using the novel SPR system and the method presented above, we can determine thin films parameters (refractive index and thickness) with high accuracy. As compared to ellipsometry, where the thickness and refractive index could be simultaneously determined only if the layer thickness exceeds 15 nm, this method was successfully used for a 3 nm thin film.

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