Fresnel model and Effective Medium Approximation (EMA) in Spin Hall Effect of Light ellipsometry for surface measurement of optics

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The spin hall effect of light (SHEL) has been receiving spotlight particularly after the demonstration of weak measurements that ease its observation. SHEL is a phenomenon where the reflected light beam split into right and left circularly polarized light due to gradient of refractive index. SHEL observation with weak measurement is realized by a pair of polarizers to define the pre-selected and post-selected state of the light. Then, by recording and detecting the transverse shift distance of the reflected SHEL, the optical properties of the surface can also be measured. In this paper, the SHEL ellipsometry is proposed as surface area measurement. Two models are used for data analysis to draw the surface properties of the sample. The first model is based on the smooth surface assumption called the Fresnel model and draws surface mapping in terms of refractive index. The second model is based on the assumption that the sample has some degree of roughness, so the effective medium approximation (EMA) model is used, which is also commonly used in conventional ellipsometry. In the EMA, the roughness is considered as a fictitious thin layer with different refractive index and effective thickness. The EMA model offers surface mapping in terms of effective thickness. The proposed method shows a promising potential as an alternative for a large area nanoscale surface measurement.

Keyword: Surface measurement, Spin Hall Effect of Light, Refractive Index, Effective Medium Approximation, Fresnel model.