

Thursday Evening Poster Sessions, October 24, 2019

Spectroscopic Ellipsometry Focus Topic

Room Union Station B - Session EL-ThP

Spectroscopic Ellipsometry Focus Topic Poster Session

Moderator: Tino Hofmann, University of North Carolina at Charlotte

EL-ThP1 Teaching Ellipsometry to Undergraduates, *John Woollam*, University of Nebraska-Lincoln

Ellipsometry is taught at universities at different levels. This class is a beginning course at the undergraduate level for students who have not had classes in optics or solid-state physics. We use Fujiwara's *Spectroscopic Ellipsometry*¹, Collett's *Field Guide to Polarization*², and other sources for basic theory. We have simple in-class experiments to demonstrate basic concepts. The most unique aspect of our class is the use of a 1960s Gaertner model L119 manual null ellipsometer. The instrument is ideal to demonstrate alignment of light source, rotation axis of instrument, and sample to rotation axis of instrument. In addition, students "calibrate" P_s and A_s , the azimuth offset positions of the polarizer and analyzer. They learn practical aspects of polarizers, retarders, and multiple reflections from optical elements. They measure P- and S-reflectance vs. angle of incidence and compare to predictions by Fresnel equations.

Students measure polarization state of light by null ellipsometry, rotating analyzer ellipsometry (by hand!), and Stokes parameter methods. They compare results of all three methods and explain sources of systematic and random errors. They are then shown how modern ellipsometry instruments drastically reduce both types of errors. The course generally has 6 to 8 students, making laboratory aspects practical and educational. The combination of classroom demonstrations, theory, and hands-on experiments is both fun and an effective learning process.

1. H. Fujiwara, *Spectroscopic Ellipsometry* (Wiley, West Sussex, England, 2007).
2. E. Collett, *Field Guide to Polarization* (SPIE Press, Bellingham, Washington, 2005).

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