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Comparison of three methods for ellipsometry Characterization of thin absorbing films

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Ellipsometry is a surface and film analytical technique which takes advantage of the fact that light reflecting from a surface undergoes a change in polarization state depending upon the geometric structure and materials of which it is composed. The predicted change is expressed in a mathematical model containing the surface descriptive parameters. In the common measurement scenario some of these parameters may be known and some, unknown. Thus the method requires data analysis to put measurement and theory into agreement. The purpose of the work here is to take the exact same films and measurements and to make a direct comparison between different methods for determining the model and achieving agreement with computed measurements. The three methods are that of Yamamoto which solves for pairs of measurements on growing films, the method in common use which seeks statistical agreement using simultaneous data regression algorithms, and the methods in the n-k plane which cast the problem into a deterministic mathematical expression for solution. Three different materials systems are explored; NiOx/Si, Cr/Si, and Ni/BK7. In each case the film is absorbing and ranges from a few nanometers up to approximately 30 nm in thickness. Differences in resolution, accuracy, model specificity, and difficulty of application are presented.

Key words: ellipsometry; thin films; optical measurements; optical properties

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