IN-SITU ELLIPSOMETRY STUDIES OF THIN SWOLLEN POLYMER FILMS, A REVIEW

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The properties of a thin polymer film can be significantly affected by the presence of the penetrant. This can have potential implications for many technological applications, such as protective and functional coatings, sensors, microelectronics, surface modification and membrane separations. In-situ ellipsometry is a powerful technique for the characterization a film in contact with a penetrant. The main advantages of ellipsometry include the very high precision and accuracy of the technique, combined with the fact that it is non-intrusive. Recent advances in the speed and automation of the technique have further expanded its application.

This work provides an overview of the research that has been done by in-situ ellipsometry on penetrant-exposed polymeric films, in the last 15-20 years. The focus is predominantly on films that are not attached covalently to a substrate. The review addresses a variety of topics, covering instrumental aspects of in-situ studies, approaches to data analysis and optical models, reported precision and repeatability, the polymer-penetrant systems that have been studied, the kind of information that has been extracted, and other in-situ techniques that have been combined with ellipsometry. Various examples will be presented to illustrate different practical approaches, the consequences of the optical properties of the ambient, and the various ways that have been employed to bring polymer films in contact with a penetrant, ranging from simple ex-situ-like configurations (i.e. drying studies) to complex high pressure cells. The versatility of in-situ ellipsometry will be demonstrated by examples of the distinctive phenomena studied, such as film dilation, penetrant diffusion mechanisms, film degradation, electrochemical processes, and the broad variety of polymer penetrant systems studied (glassy and rubbery polymers, multilayer stacks, etc.). An outlook will be given on possible future trends.