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Characterization of Nanoscale Vapor Barrier Glass Coatings on Polymer Substrates by Ellipsometry

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Recent manufacturing processes have made it possible to deposit thin (< 20 nm thick) films of SiO_x onto polymer substrates uniformly and efficiently. These films can serve as vapor barriers and have been utilized in the food and beverage industries to extend product shelf-life. The permeability of small gas molecules like CO_2 and O_2 through polymer containers presents a major problem to many products and can be greatly diminished by the conformal deposition of thin glass films on polymer substrates. They can also serve as chemical barriers in biomedical testing micro-plates. The films are deposited using plasma enhanced chemical vapor deposition processing and require on-line monitoring of their thickness for quality assurance. The focus of this project was to characterize the thickness of the thin glass films on polymer substrate such as polyethylene terephthalate (PET) using ellipsometry based measurement techniques. A simple ellipsometer constructed of a linearly polarized helium-neon (HeNe) laser, quarter waveplate, linear polarizer, and photodetection system was developed along with a signal analysis algorithm for rapidly measuring the thickness of 100 to 200 angstrom films. Measurement results for SiO_x on PET will be compared against those obtained with thermally grown oxides and gold films on silicon substrates, typically employed in microfabrication processing.