BUCK Scientific

Application Note

#IR3003

Accurate Determination of Film Thickness by Fast-Scanning IR

Problem

Semiconductor components are made primarily from surface-doped substrates of silicon, gallium arsenide, mercury-cadmium telluride, and other highly refractive metalloid materials. Special lenses and mirrors usually have a specific coating to impart some required optical property (anti-glare, UV-blocking, color-correction, etc).

Polymer films used in packaging and manufacturing are often made to certain thickness specifications. These films can either be pure, single-component plastics, co-polymers, or multi-layer laminates. *All* of these products need their respective surfaces, coatings, or layers accurately measured for QC or R& D purposes, but are too thin for direct physical measurement and too difficult to measure with cross-sectional microscopy.

Principle

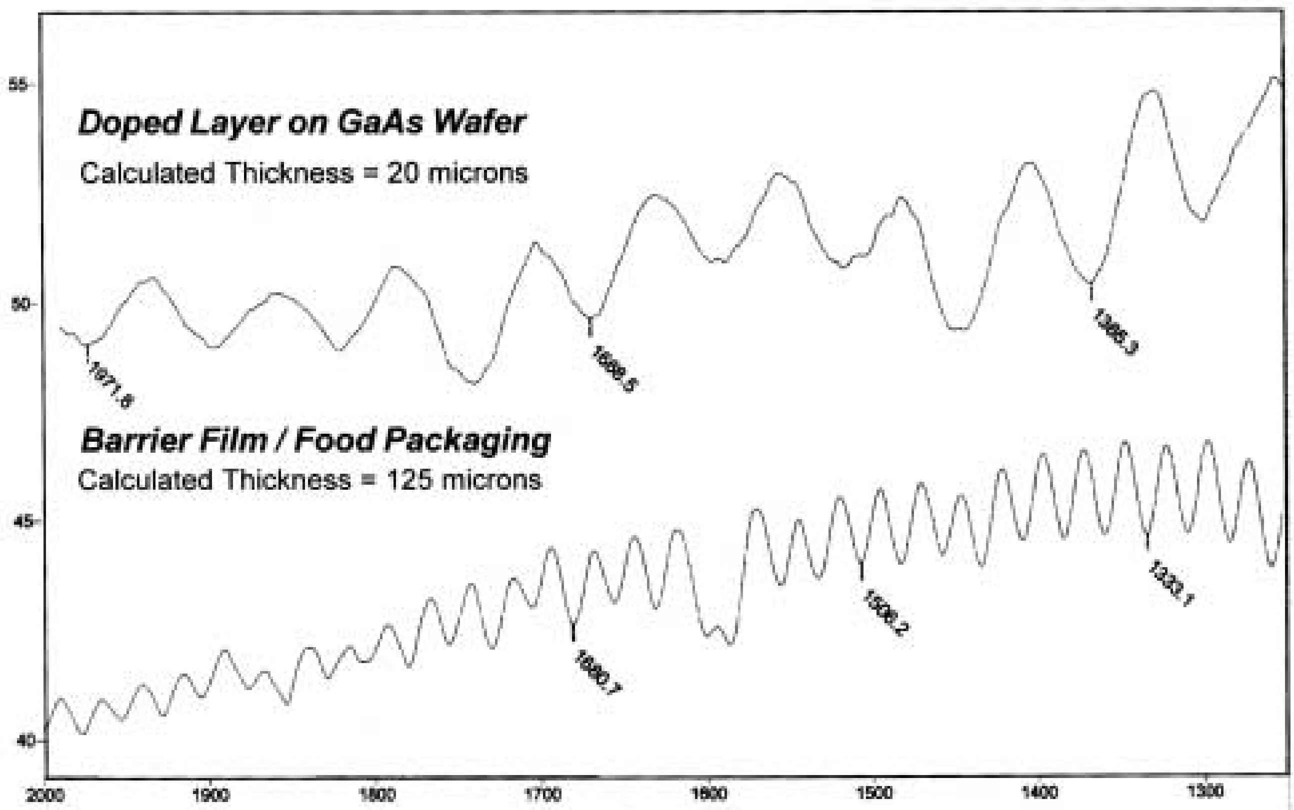
Place the sample in the *transmission* path of a beam of Infra-red energy and scan the sample with a monochromator-based system. There will be some distortion of the IR light based on the interaction of a specific wavelength of IR energy and the refractive index (and differential) of the sample/layer. This distortion creates a pattern known as fringing, and can be used to determine film thicknesses from as small as 2 microns up to 2 millimeters! Since the accuracy of the fringing is dependent on the interaction of *individual* wavelengths of IR with the sample, the best data quality is obtained from a *scanning* based system as opposed to an *interferometer* based design, where all the energy is measured at once. Epitaxial layer and thin film thicknesses were a standard method for the old-style, double-beam dispersive instruments for several decades.

Practice

A magnetic film holder is placed in the sample compartment of the Buck Scientific M500 Scanning IR system. The sample is secured in place, perpendicular to the beam. Using the GRAMS®/AI software package, a scan of the sample is obtained and the transmission spectrum generated. Optional programmed sequences in the software will automatically pick the spectral range for a series of fringes, and then count the number of fringes within the region and calculate the thickness based on refractive index. A “mean” thickness can be accurately determined by calculating several areas of the spectrum. A complete analytical cycle takes less than 5 minutes.

SIC: 222, 226, 227, 228, 229, 265, 267, 275, 307, 308, 382

Layer & Coatings by Fringe Counting



The gallium arsenide wafer was run by transmission using a modified film holder and a "map" was made to verify the uniformity of the doping throughout the wafer. The barrier bag film was scanned using the magnetic film holder.

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