Glass measurement using white light interferometry

Whether producing float glass, tubing, bottles, or other products, thickness measurement is one of the critical parameters in a successful operation. Steve Heveron-Smith* describes how an all fibre-based interferometer can work in different glass applications.

Common methods for measuring glass include laser triangulation, spectrometers, digital micrometers, and manual touch gauges of various types. Manual touch gauges have all the issues inherent to manual measurements including variability based on user, longer time to measure, data integrity and operator error. Automated gauges like spectrometers, and laser triangulation gauges remove the data integrity and time to measure issues, but often result in issues with set-up and usability.

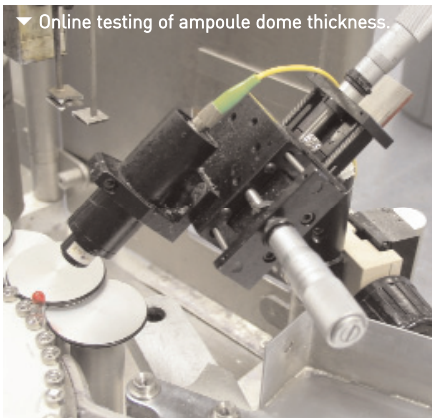
Technology

Lumetrics has developed an all-fibre based interferometer called the OptiGauge. Traditional white light interferometers use a mechanical rotating flywheel with mirrors to provide the core function of creating interference fringes - what the system measures. The rotating flywheel is used in conjunction with free space optics, which channel a light beam through a series of mirrors and prisms and then out through an optical fibre to the probe and measured surface. These mirrors can be subject to alignment and use issues over time.

With the OptiGauge system in place of the rotating mirror, the company has designed a fibre wrapped piezo coil to provide the interference fringes. The piezo coil works on the principle that when electricity is connected to it, the piezo material expands or contracts. The fibre is glued onto the coil with a special epoxy and when the piezo stretches or contracts it changes the length of the fibre. This provides the same effect as the rotating mirror with none of the moving parts and limitations. Because of the piezo coils, the system uses no free space optics. Therefore, alignment issues can be eliminated, motor and bearing wear non-existent, and the system is able to withstand environmental factors easily.

The piezo coils can be operated at rapid speeds in the Megahertz range. The system currently operates in the range of 20 - 200 measurements per second. Each sample in the current sampling rate is comprised of thousands of data points per sample. Data collection speed is balanced against processing speed of the collected data. The Lumetrics processes in real-time and displays the data as it is collected. The OptiGauge can measure any thickness from 0.015mm – 35mm. With an accuracy of .1 microns (0.000004") it provides users with the ability to track their production and bring glass thickness tolerances to unprecedented levels.

The OptiGauge directs the beam of light through a probe at the surface to be measured. Reflections from each surface the beam encounters are directed back up through the probe and into the interferometer for analysis. A critical component of the system is the relationship of the probe to the surface being measured. The probe must be positioned 90° to the surface +/- the tolerance of the particular probe. Lumetrics provides standard probes for various applications and these probes have tolerance ranges of 2°- 5°.


Online testing of ampoule dome thickness.

Positioning the probe perpendicular to the measurement surface is the art of an OptiGauge installation. Lumetrics mechanical engineers are experts at understanding a problem and then designing fixturing and apparatus to position the probe correctly. Some fixturing is as simple as a lab stand with X/Y stages, and it can be as complex as robotics or other scanning systems.

Markets

Since 2003 Lumetrics has worked with glass manufacturers in the measurement of their glass products. Its systems measure float glass and coatings at the hot end and even in a tin bath. They measure water glass and other multilayer products such as safety glass without contact and non-destructively. OptiGauge technology measures tubing of various sizes both online and in the lab. Additionally, it measures bottles, large speciality light bulbs, and other round and shaped glass objects for industrial and medical applications. The technology is also used for in-process glass slimming measurements. These glass slimming applications use hydrofluoric acid, an extremely dangerous process. ■

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