# MEASUREMENT OF FILMS ON CURVED SURFACES

There are many cases when coating is deposited on a product with curved/non-flat surfaces. Some examples are hardcoat layers on headlights in automotive manufacturing process, polymer or other biocompatible coatings on medical implant devices, coatings inside the tubing (e.g. syringes). Traditionally, it was challenging to measure these coatings and witness samples were frequently used to enable accurate measurement.

MProbe system allows measuring coatings on curved surfaces quickly and reliably using either manual probe (CSH) or microscope option. Manual probe has a soft rubber bottom and can be placed directly on a curved part. There are 2 models of the manual probe: CSH (measurement spot ~ 2mm) and CSHF (measurement spot ~ 200μm) that can be used depending on the application. The probe conforms to the curvature of the sample and accurate measurement can be performed easily. It is used for measurement of the parts larger than 1" (25mm). For small parts (<25mm), such as most medical implants, etc. - a microscope option is frequently used. In this case, the small measurement spot size (typically, <40μm) makes the effect of curvature negligible.

## I. AUTOMOTIVE HEADLAMP APPLICATIONS

There are several points in automotive headlamps manufacturing process where coating thickness can be critical and requires quality control: outer hardcoat layers (scratch- resistant), inner anti-fog layers for polycarbonate lenses, hardcoat on base reflector plates. Each of these coatings presents a unique set of measurement challenges: low optical contrast between polycarbonate and coating material, inter-penetration/interface layer, colored parts (e.g. red), reflective texture on the part surface, etc.

MProbe Vis system provides robust and easy to use solution. For this application, our TFCompanion software uses advanced Fast Fourier Transform (FFT) algorithms – that can be easily adjusted/trained to measure even most challenging samples. Measurement process is easy for inexperienced operator to use and understand.

Coating lab operator can quickly and easily measure parts right after removal from the coating system.

83 Pine Hill Rd. Southborough, MA 01772
Phone +1.617.388.6832 Fax. +1.508.858.5473
email: info@semiconsoft.com http://www.semiconsoft.com

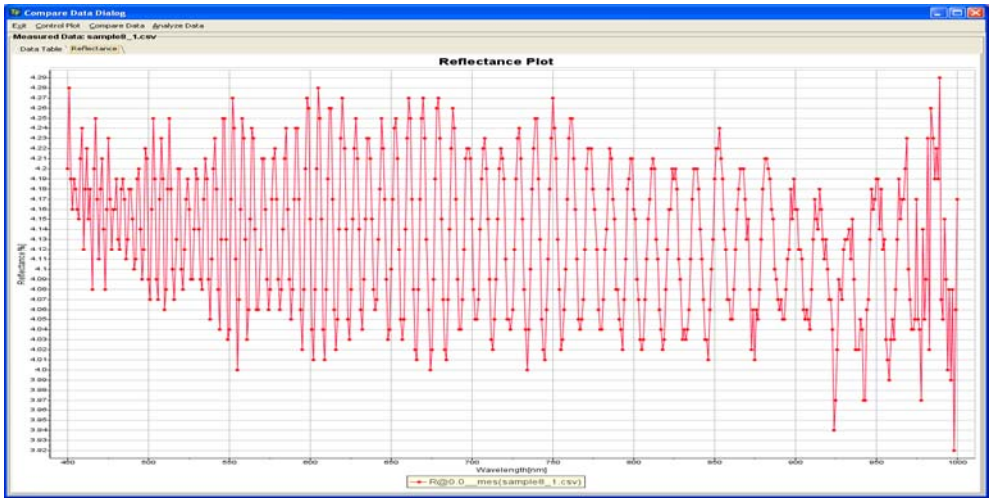


**Fig. 1a** Clear headlight with hardcoat: Reflectance spectra measurement. (see results Fig. 1b)

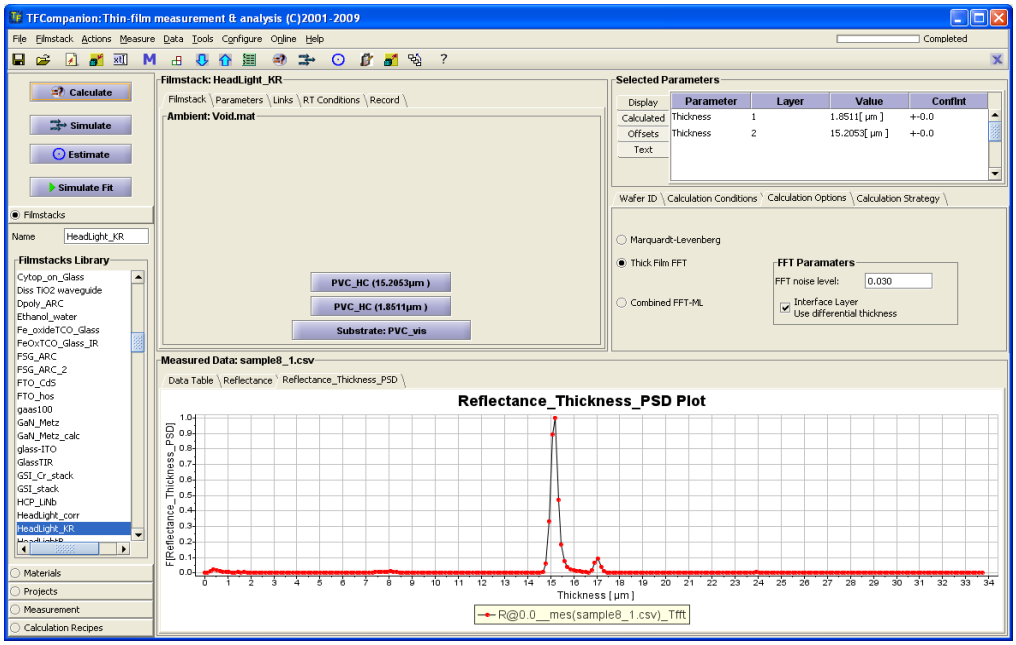


**Fig. 1b** Results of the measurement of clear headlight with hardcoat. Hardcoat thickness- 15.2 µm; IPL (interface layer) thickness - 1.85 µm (First peak corresponds to hardcoat layer; second peak corresponds to the total thickness hardcoat+IPL)

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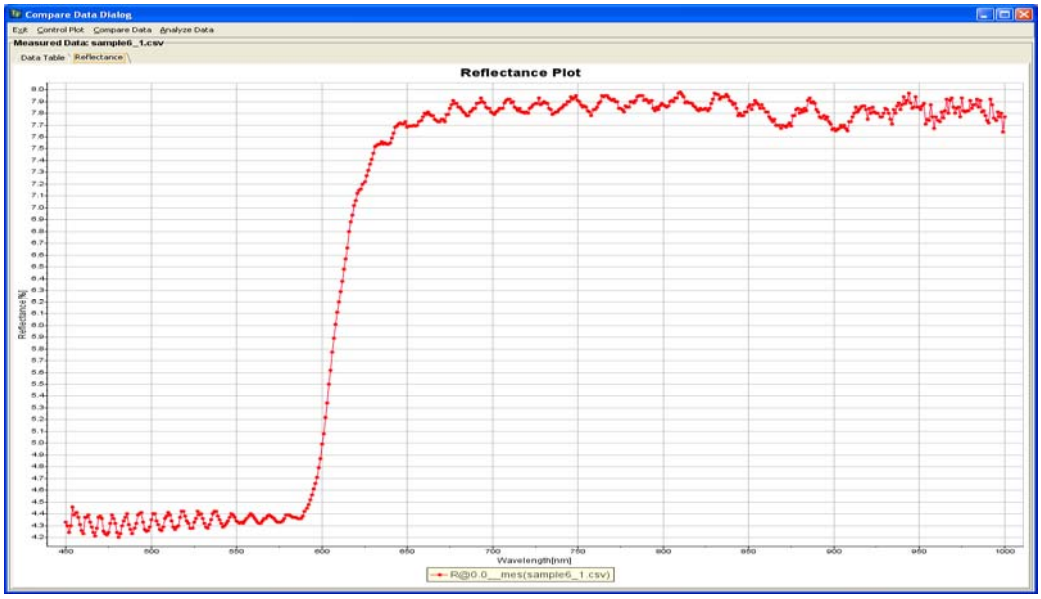


**Fig. 2a** Red headlight with hardcoat (on textured surface): Reflectance spectra measurement. (see results Fig. 2b)

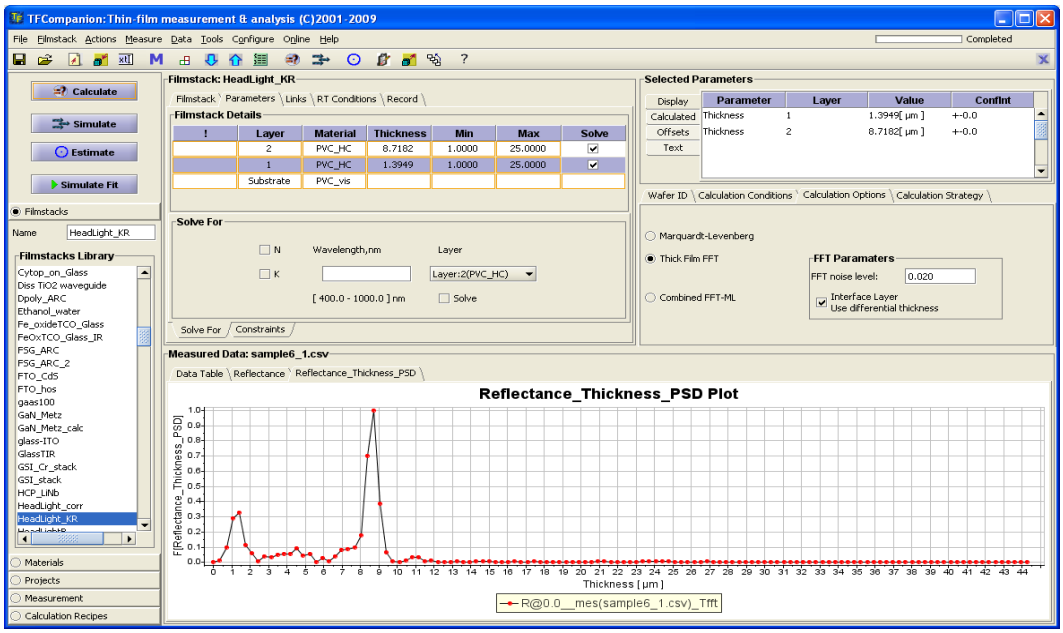


**Fig. 2b** Results of the measurement of the red headlight with hardcoat.
The hardcoat thickness - 8.7 µm, IPL (interface layer) thickness - 1.4 µm

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## II. Coating inside transparent tube.

In many case, coating need to be deposited inside a transparent tube e.g. beverage bottles are coated inside with inert materials; medical syringes are coated inside to enable smooth movement of the plunger, etc. All of these applications have specific measurement challenges but some of them are similar: light scattering due to surface roughness and material imperfections, low reflectivity from the measured layer.

Below is an example of a measurement of the polymer coating inside the syringe barrel. The measurement is done with MProbeVis-Micro system using 40 µm measurement spot. The syringe barrel was ~ 15mm diameter transparent (slight matted/milky) polymer tube.

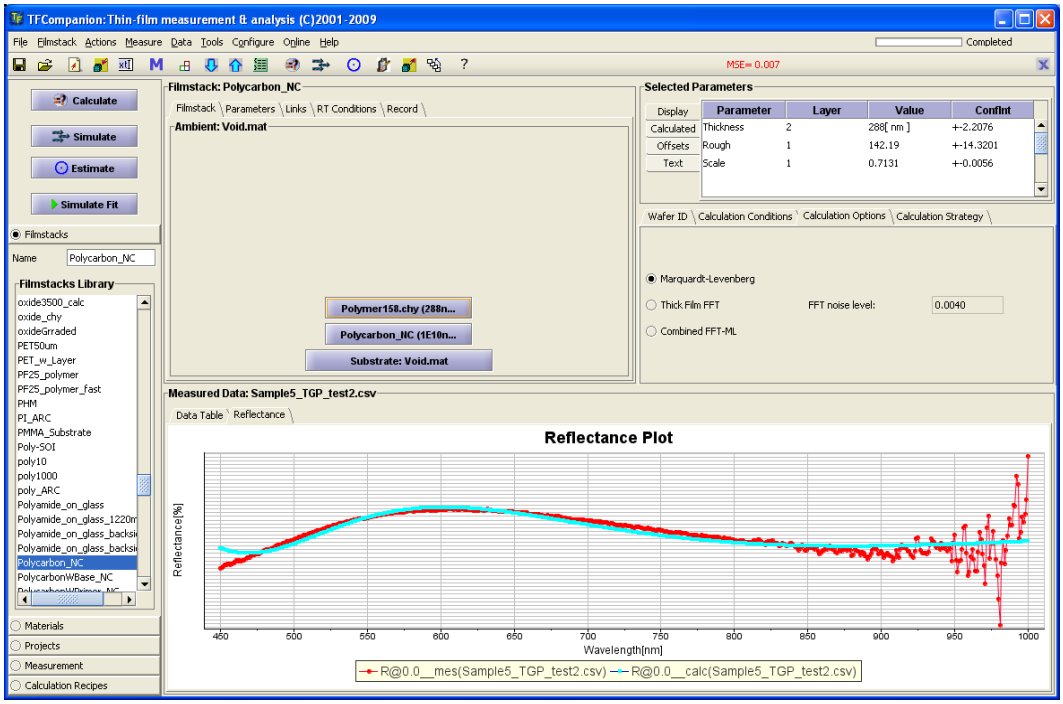


**Fig. 3**. Measurement of the polymer layer inside the syringe tube. Measured vs. model data, scattering and surface roughness correction is applied. Thickness: 288nm


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### III. Coating on medical devices/implants.

Medical implants need to be coated with polymers or other biocompatible materials. Some of the challenges are small size/ sharp curved surface, scattering from the metal surface. In case of non-polymer coatings – optical properties (n&k) need to be also determined as they may depend on the deposition conditions. Measurement is done using small spot (~ 40um) and the light scattering is corrected.

Below is the result of the measurement coating (Ti/Al oxide) on Ti nail. Nail is ~ 6 mm (0.25") diameter.

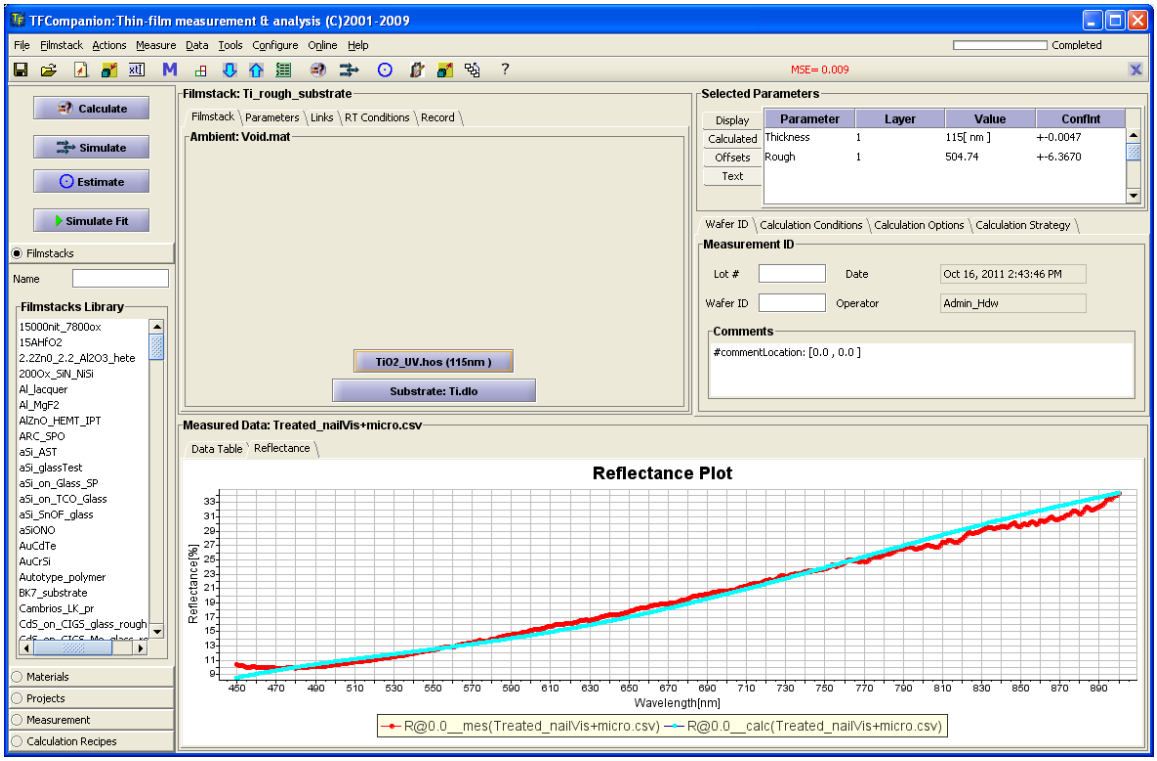


**Fig. 4** Results of the measurement (measurement vs. model) of the coating on Ti nail. Oxide coating material dispersion is represented using Tauc-Lorentz approximation. Light scattering is corrected.
Thickness: 115nm

### In-Line Coating Measurement

MProbe Vis with manual probe is ideal in coating lab for quality check of films on curved surfaces. At the same time, the system uses fiberoptics probe (hence, flexibility of distance and measurement location) and is well suited for in-line coating measurements. Semiconsoft, Inc. has built a Modbus (TCP) compatible interface for easy communication through the factory controller (other integration option including custom software/hardware integration are available). This enables process monitoring on "Go/No-Go" basis for 100% quality control.
Contact Semiconsoft, Inc to learn more about measurements options and capabilities.

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