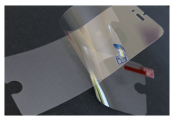
HORIBA Scientific

Use of complementary techniques for depth profiling of mobile screen protection covers



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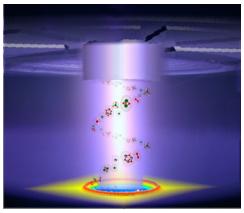
Motivation

Since smartphones entered our daily life, splintered mobile screens are an annoying side effect. Many efforts are undertaken to produce efficient protection covers for mobile screens.

Besides real glass cover foils, which also tend to be fragile, the development of efficient protecting polymer covers has been established. As simple as such polymer foils look like, as demanding is the polymer technique behind. Controlling the production process, to ensure reliable protection capability for large batches, is required to guarantee a consistent quality. **Analytical depth profiling methods are the means of choice by which such polymer films can be analysed in terms of composition and layer structure.** Acting in this manner, HORIBA Scientific (HSci) shows the potential of combining its two techniques, GDOES and micro Raman spectroscopy, to obtain a comprehensive picture of mobile screen protection covers.

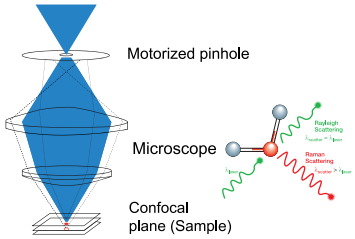
GDOES & UFS

The GDOES analysis relies on the **sputtering of a representative area of the material of interest** by a dense plasma, operated in pulsed RF mode. Thanks to the Ultra Fast Sputtering (UFS) mode, patented by Hsci, the GD profiling of polymers can now be efficiently achieved (~10 µm/min).



Confocal micro Raman spectroscopy

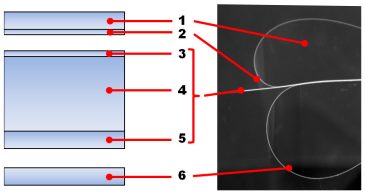
While GD-OES gives access to the elemental depth profile, Raman is capable to provide information about molecular composition of the polymer layers. The principle of Raman consists of an **inelastic scattering of photons.** The energy of the inelastic scattered photons correspond to a specific molecular vibration.



Principle setup of a polymer screen protection cover

The principle setup of a **Polymer Mobile Screen Protection Cover (PMSPC)** consists of a multilayer polymer system containing the

- Protection cover for the mobile screen (3 / 4 / 5)
- Covering foils acting as protection and carrier filmsfor the PMSPC (1 / 2 and 6)

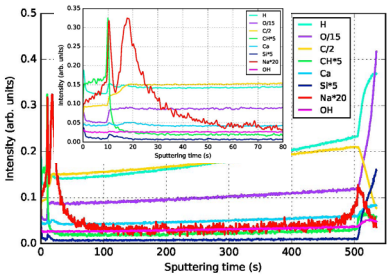


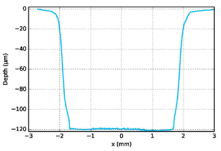
1. PET carrier film
2. Low adhesion film
3. Hard coating
4. Protective film
5. Adhesion film
6. Disposable realease liner

UFS GDOES analysis of PMSPC

The UFS-GDOES analysis was carried out starting from the surface of the thin top layer 3, after the removal of the PET carrier film.

a) The sputtering time 0 – 10s can be addressed to the **hard coating layer 3**
b) After 10 s the CH signal shows a clear peak and a high Na content, indicating that **the interface between layers 3 and 4** is achieved.
c) At 20 s a **second Na peak** appears decreasing towards the bulk material.
d) After 500 s the Si & H content increases indicating the **transition to layer 5**.
e) After 600 s the **PMSPC is fully sputtered** (120 µm crater, by profilometer)

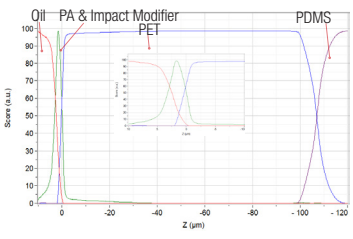


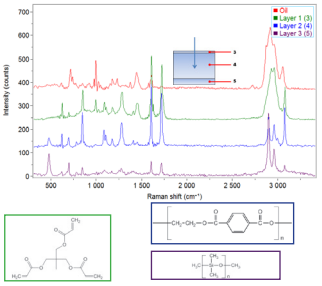


Raman analysis of PMSPC

The Raman Z-scan analysis was carried out from the same top surface of layer 3, as for the GDOES analysis. An oil immersion objective was used.

a) At the very beginning of the z-Scan the **immersion oil** is detected.
b) The first layer shows a **complex composite spectrum** consisting of: oil, poly (ethylene terephthalate) (PET) spectrum originating from the layer below and above and the spectrum of a branched poly acrylate (PA) containing an impact modifier. This 2 µm thick layer acts as a hard coating.
c) The second layer shows the spectrum of PET, which is nearly 100 µm thick and represents the main part of the PMSPC.
d) The third layer shows the spectrum of poly (dimethyl siloxane) (PDMS). This layer acts as an adhesive.





Interpretation & Conclusion

Micro Raman and UFS-GDOES are useful complementary techniques for depth profiling of complex multilayered polymer materials. The results given by both methods are in excellent agreement.

The **GD analysis** shows the **presence of a Na peak at the interface between the hard coating and the PET layer.**
Such Na content could be due to the presence of a ionomer of poly (acrylate acid) Na salt. These polymers, typically, are «self-sealing» and are included in coatings of sensitive electrical wiring to keep moisture away from the wires, ensuring the safe transmission of electrical signals. Moreover, **PETs are thermoplastic,**
Therefore they are produced by thermic molding. This could explain the **interfacial segregation of Na**.

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