

Analysis of the cause on troubles of polymer film products

IX-13

There are many causes of troubles to be possible to occur on the film. They are assigned to the external factors and the internal factors. Foreign substances and surface contamination are the external factors, and segregation, aggregation and volatilization of additives as well as discoloration by chemical structure changes are the internal factors. We can propose the effective analyses to find out the causes of troubles from our abounding experiences.

External factor① Foreign substances

Foreign substances in/on films bring on not only smearing their appearance but also inducing bad stacking and coating on the manufacturing process and nonuniformity. Fractures might be occurred if foreign substances exist inside of films.

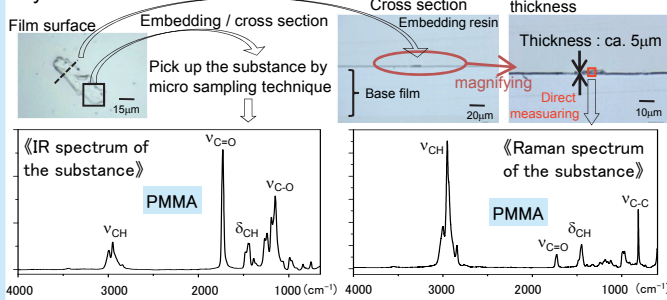
<Analytical methods>

- Appearance of substances on/in films...Optical microscope, SEM
- Picking up the substance by micro-sampling and measuring it

《Analytical methods for substances》

size	1 μm	10 μm
Organic	Micro Raman μ-MS	Micro FT-IR Pyrolysis GC/MS
Inorganic	SEM-XMA, EPMA	

< Examples of composition analyses of foreign substances on films by FT-IR and Raman >



External factor② Surface contamination

Surface contamination is not be possible of visual observation. The contamination causes many failures such as adhesive failure, print NG, deposition missing, peeling of coat, et al.

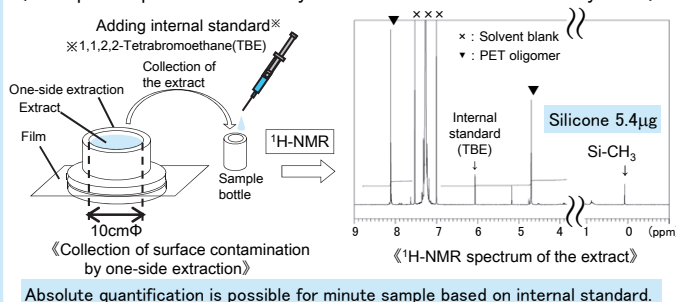
<Analytical methods>

- Overall analysis... TOF-SIMS, FT-IR(ATR)
- Extract from one-side (Possible area ; 1 ~ 10cmΦ) or collect of the contamination by rinse, wipe and polishing.

《Analytical methods》

Collection amount	1 ~ 10 μg	> 10 ng
Purpose	micro FT-IR, ¹ H-NMR GC/MS, Pyrolysis GC/MS	Pinpoint concentration/micro FT-IR Pinpoint concentration/MALDI-MS
Qualification	¹ H-NMR (internal standard) GC, HPLC	LC/MS/MS GC/MS SIM

<Example of quantification analysis of silicone oil on PET film by NMR>



Internal factor① Segregation and condensation of additive

Blooms and breeds : moving of additive to film surface
Fogging : attaching on peripheral glass and wall by volatilizing
Trouble similar to surface contamination occurs.

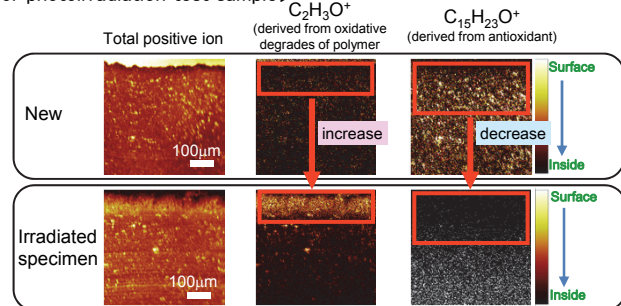
《Surface analyses》

Depth	Method
~nm	TOF-SIMS, XPS
~1μm	micro FT-IR(ATR), micro Raman

《Distribution in cross section》

Resolution	Method
~1μm	TOF-SIMS
~10μm	micro FT-IR(ATR)

<Example of TOF-SIMS characterization for cross section of coating film for photoirradiation test sample>



It is found that the polymer was degraded in surface region and the antioxidant was decreased.

Internal factor② Coloring, Discoloring

Coloring and discoloring can ensure by reforming of film polymer components, structural changes of additives such as antioxidant, and modifications such as dimerization. These decrease transparency and grade of films.

<Analytical methods>

- Analysis of discoloring part : UV-VIS, Raman et al.
- Extraction of coloring part by solvent
(Collection of reforming additives and low molecular weight components)
- Qualification of collecting matters
HPLC/UV, LC/MS/MS, MALDI-MS combined with micro-GPC fractionation

<Example of LC/MS/MS analysis of transformed antioxidant>

