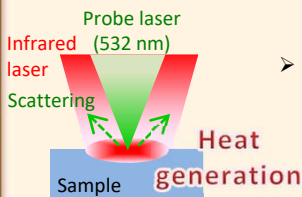


Composition analysis of foreign substances by optical-photothermal IR spectroscopy (O-PTIR)

Optical-photothermal IR spectroscopy (O-PTIR) enables to obtain infrared spectra in non-contact manner with about 1 μm spatial resolution. We applied O-PTIR to analyze small foreign substances which were impossible to be analyzed with conventional micro FT-IR because of their position and mechanical properties.

Principle and characteristics of O-PTIR

Principle



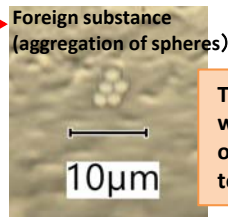
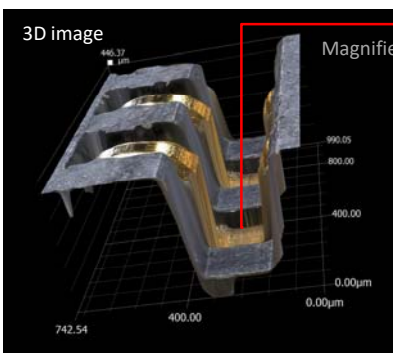
Detected sensitivity depends on IR absorptivity and thermal expansivity of sample itself.

- Sample absorbs infrared laser and diffuses its energy as heat, which cause sample deformation.
- Collimated visible laser (532 nm) detects the sample deformation, which can be converted as IR spectrum.

Characteristics

- IR measurement with about 1 μm spatial resolution (conventional micro FT-IR is at most 10 μm)
- Acquisition of the same spectra as FT-IR
- Non-contact measurement using probe laser, which enables IR measurement for small foreign substances if they can be observed with optical microscope
- Combination with other analysis available (e.g. SEM-EDX, TOF-SIMS, Raman)

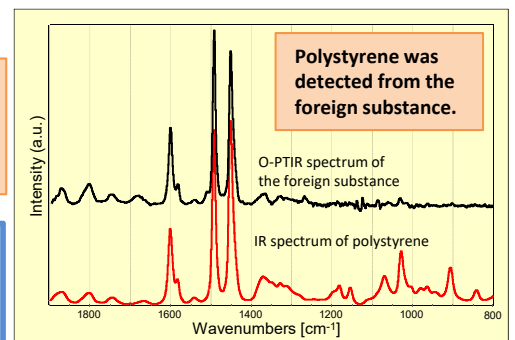
Analysis of foreign substances on a circuit



The foreign substance was located on a circuit of 450 μm in depth from top of the sample.

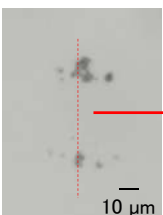
- Impossible to pick up the foreign substances
- Other sample preparation is also impossible due to its size (too small) and sample shape
- O-PTIR measurement was conducted.

O-PTIR analysis result

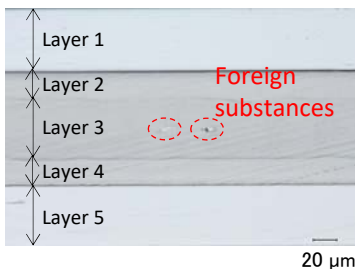


Analysis of foreign substances inside a multi-layered film

OM image



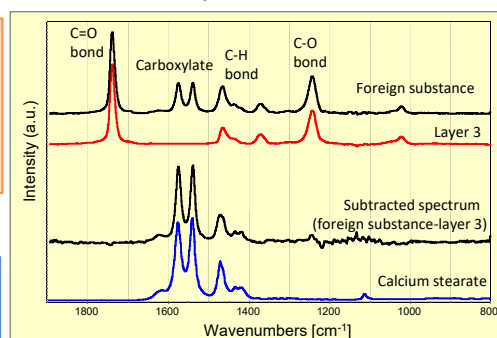
Sample cross section



The foreign substances in 6-10 μm size were inside layer 3.

- Impossible to measure the foreign substances from sample surface
- Difficult to collect the foreign substances due to sample size and location
- O-PTIR measurement was conducted with sample cross section.

O-PTIR analysis result



Rich aliphatic carboxylate (e.g. solid lubricant) was detected from the foreign substance.

O-PTIR analysis is effective to analyze small foreign substances in various samples (e.g. on intricate shape sample such as semiconductor, on adhesive, inside polymer material such as film), and we can acquire many information of chemical structure with high spatial resolution and non-contact measurement.