Application Note

No. 260NF0191-E

Measurement of submicron particle by NFIR (Near Field Infrared Spectroscopy)

Introduction

Research and development of microstructure which is called nanotechnology have been expanding in the field of several devices such as semiconductor and liquid crystal. Moreover in the field of life science, nanoscale studies such as structure and function of biological tissue are now expanding rapidly. Vibrational spectroscopy is an extremely efficient method in order to analyze molecular structure and chemical binding easily for those purpose without destruction, however, since the spatial resolution depends on the wavelength of the light applied, the size of the measurement area has been limited to 1 mm by Raman spectroscopy and 10 mm by conventional transmittance infrared spectroscopy. However, measurement in the area of submicron is now getting capable by Near field infrared spectroscopy system using light scattering probe. Spectrum measurement of submicron particle will be explained in this application data.

Experimental

1) Polystyrene particle (2 mm) on Al mirror
   Slurry of polystyrene particle (average 2 mm) was dropped on Al mirror and dried. The area where particles were distributed properly was measured.

2) Silica ODS particle (4 mm) on GaAs board
   Slurry of ODS particle (average 4 mm) was dropped on GaAs board and dried. The area where particles were distributed properly was measured.

Condition

Instrument:	NFIR-200
Measurement area:	20 x 20 mm
Accumulation:	128 time
Resolution:	8 cm^{-1}
Apotization:	Cosine
Detector:	MCT

Photo 1 NFIR-200 Near field IR spectroscopy system

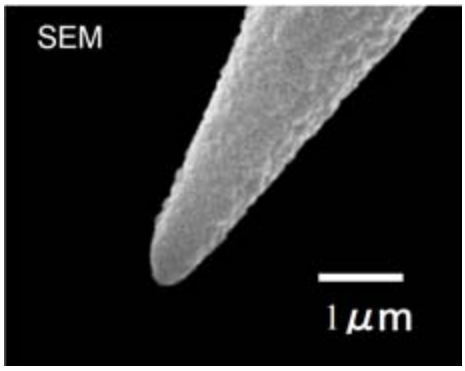

Photo 2 Magnified light scatting probe

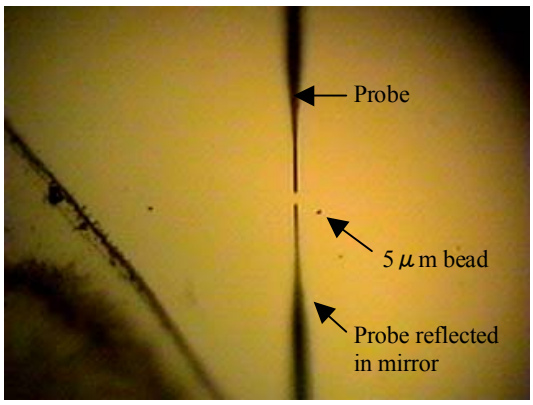

Photo 3 Polystyrene particle on Ao mirror (CCD image)

JASCO INTERNATIONAL CO., LTD.
4-21, Sennin-cho 2-chome, Hachioji, Tokyo 193-0835, Japan
Tel: +81-42-666-1322, Fax: +81-42-665-6512

Results

1) Polystyrene particle on Al mirror (2 mm)
This is the measurement result of one polystyrene particle on Al mirror. As in Photograph 3, the edge of prove was moved to objective position by monitoring CCD image. Measurement area by Near field infrared is up to 20 x 20 mm. Starting position of measurement was determined in the effective area for measurement by moving X-Y stage. Measurement conditions such as accumulation and resolution were determined depending on peak intensity and noise level of spectra. Moreover, by using Near field infrared system, topographic measurement can be done, which is not enabled by conventional and microscope IR. Figure 1 shows result of topographic measurement. Single particle with the size of 2 mm was recognized to be placed clearly on Al mirror. Topographic measurement enables obtaining concavoconvex information in all area of measurement, and elucidating the position where particle is located. Styrene absorption at 3025 cm^{-1} was confirmed.

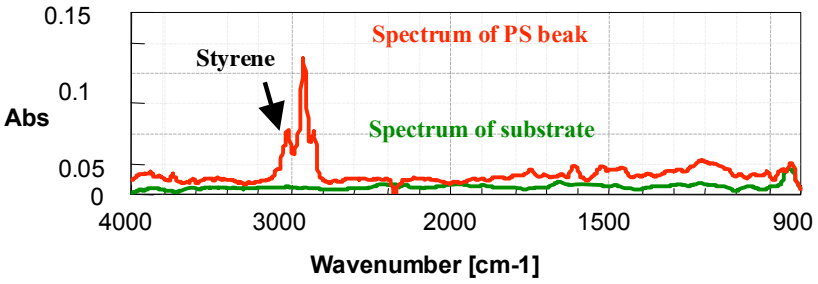

Fig. 2 NFIR spectrum of PS beads

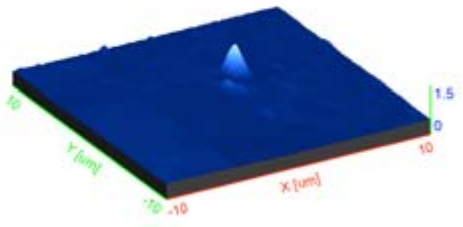

Fig. 1 3D display of topographic image

2) Silica ODS particle on GaAs board (4 mm)
Topographic image indicated the size of ODS particle as approximately 4 mm. Near field infrared spectrum of single particle was obtained at the position of particle, and absorption of CH from ODS (Octadecyl silane) and absorption of SiOH from silanol group were identified as in the spectrum. Figure 4 shows microscopic photograph of ODS particle.

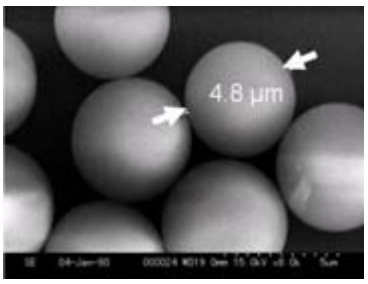

Photo 4 Photograph of ODS by Elecctron Microscope

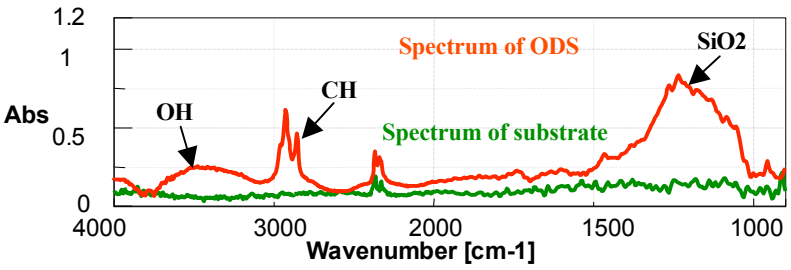

Fig. 4 NFIR spectrum of ODS beads

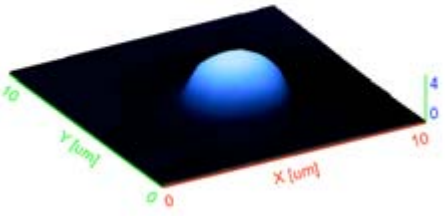

Fig. 3 3D display of topographic image