Application Note

170-AN-0025

Evaluation of the component distribution and particle analysis using micro Raman spectroscopy

Introduction

Analysis using Raman a spectrophotometer does not typically require any sample pretreatment; measurement can be performed non-destructively and without direct contact. Therefore, it is possible to evaluate the component distribution while maintaining the sample integrity. In addition, with the JASCO Particle Analysis program it is also possible to evaluate the variation in particle size and shape, etc. The particle size distribution can be displayed as a histogram together with sample shape information from the observed image, combined with the chemical images. This method is particularly useful for the analysis of a variety of different materials such as resins, foods, pharmaceuticals, and microplastics.

Figure 1. NRS-5500 Raman Spectrometer

In this application note, we evaluated the distribution of diamond in a diamond polishing sheet using particle analysis software.

Keywords

Raman spectroscopy, QRi, mapping, particle analysis, diamond

Experimental

A diamond polishing sheet was placed on the stage for imaging measurement.

Measurement Conditions			
Main unit	NRS-5500 Raman spectrometer	**Measurement points**	170 x 170 points (Approx. 500 x 500 µm)
Ex wavelength	532 nm	**Measurement interval**	3 µm
Exposure time	0.03 seconds	**Accumulation**	1
Objective lens	50x Long working distance		

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Results

Figure 2 shows the results of imaging measurement and analysis, in addition to diamond, cerium oxide (a glass abrasive compound) was detected in the spectrum shown in (b). When a chemical image was created using peak height for the diamond peak indicated by the blue arrows in the spectrum, it was confirmed that the diamond particles were distributed as shown in (c).

In addition, (e) and (f) show the results of analysis of (c) using JASCO Particle Analysis*. (e) is a histogram in which the particle size (diameter calculated as the equivalent circle diameter) is plotted on the Y-axis, with its almost normal distribution on the X-axis. Also, from the correlation distribution of particle size and circularity shown in (f), higher circularity is found for particles near the average size value or smaller (especially 4 µm or less). While larger particles have a lower circularity, with a greater number of ellipse- or rod-shapes. Particle analysis using histograms and correlation distributions can be useful when controlling the size and shape of the components in a final product or when evaluating products from different manufacturing processes or from different lots.

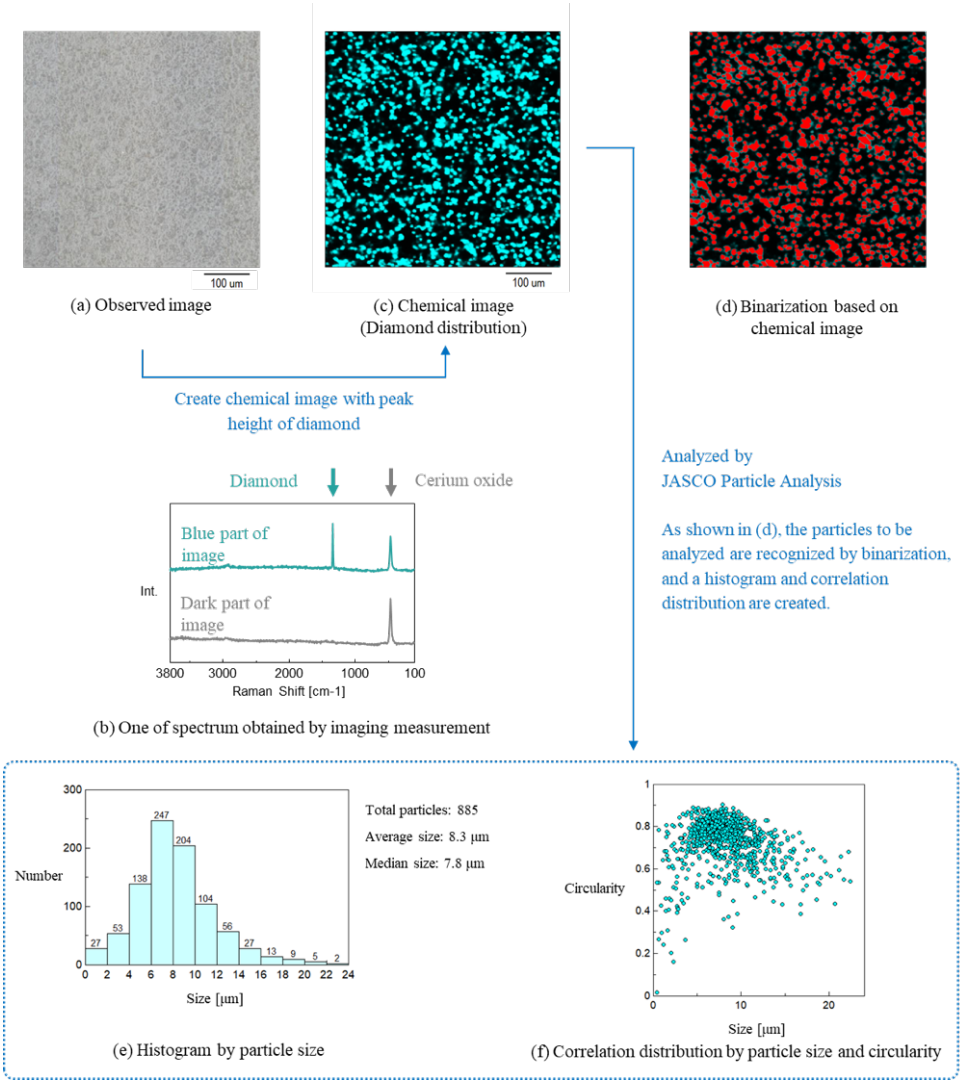

Figure 2. Analysis result

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**With JASCO Particle Analysis, in addition to acquiring the size, area, circularity, aspect ratio, etc. of each particle, histograms (which can be converted into stacked histograms), frequency distribution tables, and correlation distributions can be created easily.*

<Regarding imaging measurement>
Measurement took approx. 20 minutes (using QRI).
A spectrum with accepatable S/N was obtained for analysis with an exposure time per point of 0.03 sec (30 msec). Shortening the acquisition time or changing to a faster EMCCD detector, it is possible to further reduce the measurement time.

Conclusion

Raman spectroscopy can generally be used to evaluate the component distribution with non-destructive, non-contact, and no pretreatment of the sample. Detailed analysis is possible by visualizing the component distribution and acquiring the shape information using the JASCO Particle Analysis application.

System Configuration				
	Model	**Description**	**P/N**	**Remarks**
Main Unit	NRS-5500	Raman Spectrometer	7119-J051A	532 nm laser 100 mW laser was used, but a standard 50 mW is also available.
Options	QRI 5000/7000	QRI option	7119-J278A	
	RHG5-600B500	600 gr/mm grating	6947-J293A	
	LMPLFLN 50x	Objective lens	1108-0102	Long work distance
		JASCO particle analysis		Customized program

<Regarding imaging measurement>

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