RAMAN SPECTRA OF DIAMONDS IN THE CANYON DIABLO IRON METEORITE; M. Miyamoto, Mineralogical Institute, Graduate School of Science, University of Tokyo, Hongo, Tokyo 113, Japan.

We measured Raman spectra of diamonds in the Canyon Diablo iron meteorite to obtain information on the origin of diamond. The wavenumber position of a Raman line near 1332 cm$^{-1}$ ranges from 1333 to 1318 cm$^{-1}$, and the full width at half maximum (FWHM) of the Raman line ranges from 25 to 117 cm$^{-1}$. These results are similar to those of Raman spectra of diamonds synthesized by shock-induced high pressure [1], suggesting that these diamonds in Canyon Diablo formed by impact shock. No diamond grain which shows a relatively narrow FWHM reported by Heymann [2] was found.

Raman spectra of diamonds in an inclusion of the Canyon Diablo sample, which was supplied by courtesy of Robert A. Haag - Meteorites, were measured. The inclusion of about 0.5 cm in size locates in the rough slice of Canyon Diablo, which was cut with a carborundum blade [R. A. Haag, personal comm., 1994], and contains graphite and diamond. Diamonds, which are from about 1 μm to a few tens of μm in size, locate among graphite grains in the inclusion. The inclusion and diamonds were also observed by using a scanning electron microscope (SEM) equipped with an energy dispersive spectrometer (EDS).

Raman spectra were measured with a JASCO micro Raman spectrometer with a triple monochromator. The 488 nm line of an argon laser was focused to an area of about 1 μm$^2$ on the sample surface through a microscope (backscattering (180°) geometry). The laser power was about 3 mW on the surface of a sample. The spectra were accumulated for 10 minutes to enhance the signal-to-noise ratio by using a multichannel detector. The wavenumber position and the full width at half maximum (FWHM) of a Raman line were determined by carrying out a Lorentzian fitting of the spectra. The wavenumber position was calibrated using both the 1293.952 cm$^{-1}$ and 1343.517 cm$^{-1}$ emission lines of a Ne lamp. Spectra slit width was about 2 cm$^{-1}$ and the variation in room temperature was within ±0.5 °C.

Fig. 1 shows the distribution of the wavenumber position of a Raman line near 1332 cm$^{-1}$ for diamond grains in Canyon Diablo. The wavenumber positions are largely deviated and significantly shift toward lower wavenumbers (1318-1333 cm$^{-1}$). This large shift may be due to lonsdaleite (hexagonal diamond). The FWHM of the Raman line of the Canyon Diablo diamonds is also very large, as shown in Fig. 2 (25-117 cm$^{-1}$). The FWHM of the Raman line of diamond is thought to be related to the synthetic method [e.g., 1]. The ranges of both the wavenumber position and FWHM of the Raman line of the Canyon Diablo diamonds are similar to those of diamonds synthesized by shock-induced high pressure, which were reported by Miyamoto et al. [1]. The FWHM of the Raman line is plotted against the wavenumber position (Fig. 3), showing no correlation between the FWHM and wavenumber position. Each solid circle in Fig. 3 corresponds to individual grain of diamond. Diamonds synthesized by shock-induced high pressure show similar results [1]. The results of Raman spectra suggest that the Canyon Diablo diamonds formed by impact shock.

Fig. 4 shows the variation in the wavenumber position and FWHM of the Raman line within each grain which were obtained for some large grains having relatively small FWHM. The wavenumber position and FWHM are different in the location of each grain.

The SEM/EDS study was performed for typical diamond grains in Canyon Diablo to confirm that major element is carbon. Some diamond grains showed weak fluorescence by irradiation of electron beam.
Heymann [2] reported that a diamond in Canyon Diablo shows a Raman line at 1332 cm\(^{-1}\) having a narrow (7 plm 2 cm\(^{-1}\)) FWHM. However, no diamond grain which shows such a narrow FWHM reported by Heymann [2] was found in this inclusion. The FWHM of the Raman line for diamonds in this inclusion of Canyon Diablo is significantly larger than that for diamonds in the ALHA77257, Yamato790981, and Yamato791538 ureilites [1,3]. Further studies are required for diamonds in Canyon Diablo.

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References: