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Thermostimulated Raman spectrum dynamics of lonsdaleite

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The problem of correct diagnostics of lonsdalite phase within cubic diamond-lonsdaleite intergrowths is very good known. Possible attendance of nanocrystalline cubic diamond can be a reason of incorrect interpretation of Raman spectra. Recently we have found that lonsdaleite and cubic diamond have different spectrum dynamics under laser treatment which we explain with different reaction to laser heating (Isaenko, Shumilova, 2011). Here we present the results of the Raman study of monocrystalline lonsdaleite which was found out within Kumdykol diamond deposit in regionally metamorphosed metasomatically altered rocks (Shumilova et al., 2011).

Longitudinal sizes of analyzed monocrystalline lonsdaleite and lonsdaleite-containing particles were about 1-5 μm. High pressure high temperature synthetic co-sized diamond particles free of lonsdaleite were used for control of Raman spectra dynamics. Spectroscopic study of the samples was carried out with a high resolution Raman spectrometer LabRam HR800 (Horiba, Jobin Yvon) at room temperature. Spectra registration was performed using a spectrometer grating of 1800 g/mm, with a confocal hole size of 300 μm, slit of 100 μm, and 1–10 mW exciting radiation power of a Ar+ laser (λ = 514 nm), spectral resolution at the conditions was about 1 cm-1, spatial resolution – about 1 μm.

Recorded spectra for further mathematical processing have been decomposed into components by LabSpec 5.36 software with curve fitting procedure by the combination of Gaussian and Lorentzian functions. Analysis of positions and half-widths of Raman bands in the region of 1300-1340 cm-1 allowed us to declare the presence of several phases in the specimens with the characteristic properties to lonsdaleite, lonsdaleite and diamond, diamond and nanocrystalline diamond.

During laser heating Raman band of lonsdaleite is characterized with a large downshift (6-13 cm-1) from the initial position 1332 cm-1 and splitting to Raman active modes – E1g with the position 1319 cm-1 (with FWHM=5.7cm-1) and A1g – 1322 cm-1 (4.5 cm-1). The dynamics can be registered at laser power rising up to 12 mW during several seconds. Afterwards some back upper-shift can be visible – 1323 and 1325 cm-1 for the lonsdaleite modes correspondently. In comparison control co-sized cubic diamond particles are characterized with laser power (12 mW) downshift of a Raman active F2g mode (1332 cm-1) up to 1326 cm-1 only without any back upper-shift with time.

The Raman modes dynamics under laser heating allows provide splitting of cubic diamond and lonsdaleite modes and recognize diamond polymorphs correctly.

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