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Raman imaging of metamorphic diamonds from the Kokchetav Massif (Northern Kazakhstan)

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Diamond is a powerful ultra-high pressure mineral-indicator and pressure dependence of diamond Raman band is very useful geobarometer. Microdiamonds (up to a few hundreds microns in size) are quite abundant in some crustal-derived metamorphic rocks, but an average size of metamorphic diamond is generally very small about 15-20 microns or even smaller. The small size of diamond crystals prevents an application of traditional methods (e.g. CL, SEM and PL) for a study of internal structure of the diamonds. However Nasdala et al. (2005) have shown recently that Raman mapping of relatively large diamond crystals (a few mm in size) are very helpful for understanding of the growth processes, this methods was not applied yet for metamorphic microdiamonds. In this article we present the first results of detail Raman imaging of diamond crystal from clinozoisite gneisses. Octahedral crystals, twins and macles are predominant morphologies of the diamond in this rock type. The aim of the measurement was to perform Raman Imaging on the inclusion to determine its internal structure and composition. Additionally the strain state of the diamond inclusion was of interest. Confocal Raman Imaging was performed using an alpha300R Confocal Raman Microscope (WITec, Germany). This instrument combines an ultra-sensitive spectrometer equipped with a back-illuminated CCD camera with a high throughput confocal microscope. A piezo-electric scanning stage guaranteed sample positioning with an accuracy of about 3nm in the lateral and 0.3nm in the horizontal direction. During the scans, complete Raman spectra were acquired at every point and through analysis of the spectra. The studied sample consisted of a diamond (twin) inclusion in garnet located several microns blow the surface. The diamond specimens appear visually unzoned. There are no optically detectable inclusions within the diamond twin. No radial crack pattern or an optical birefringent halo around diamond was found during microscopic study. The results of Raman imaging of this inclusion presented below. The Raman active triply degenerate first-order F2g phonon (Solin and Ramdas, 1970) of the single diamonds studied here appears as a sharp band at 1331.4-1337 cm-1 with a full width at half maximum height (FWHM) in the range of 3.2 to 11 cm-1. The diamond shows a strong change in the intensity of the diamond line. The broadest lines are located in the center of the inclusion whereas the material closed to the diamond-garnet interface shows smaller line widths. The broader diamond band is the more asymmetric it is. It is worth noting that broader diamond band occurring in the diamond core is upshifted, however there is no reliable correlation between the position of diamond band and its FWHM value. The weak zoning pattern in diamond inclusion indicates that FWHM image is more appropriate for recovery internal structure of diamond crystals. The depth scan reveals that diamond inclusion is quite thin (5 μm) and it has slight inclination. No other phases were found along the garnet-diamond interface.
Contrary to diamond inclusion there are no measurable upshifts or broadening of main garnet bands, without any indication for additional internal garnet heterogeneity (i.e. structural differences, differences in composition or strain pattern). Complex internal texture was found for diamond inclusions in garnet by Raman imaging. The sample showed a large variety of components (e.g. FWHM, intensity, band position) within the diamond phase, which could be found both in the XY as well as in the YZ scan. We believe that these variations associated with diamond growth processes. An upshift and broadening of diamond band for metamorphic diamonds is a good indicator of growth processes, but it can be hardly used for recovery residual pressure and estimation of peak metamorphic conditions. This study was supported by the RFBR grants (10-05-00616-a)
1 Nasdala L, Hofmeister W, Harris JW, Glinnemann J. Am. Mineral. 2005; VOL: 90 745.
2 Solin SA, Ramdas AK. Phys. Rev., B 1970; VOL 1 1687.