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SPECTROSCOPY APPLICATION FOR MODELLING OF TRANSFORMATIONAL MECHANISMS OF LATTICE DEFECTS IN DIAMONDS DURING ANNEALING AND IRRADIATION

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There is still some concern about mechanisms of defect transformations and structure of some lattice defects in diamonds. This work is performed for better understanding of processes which take place in diamond lattice during irradiation and annealing.

Samples of natural and synthetic diamonds were investigated by means of VIS-IR-range absorption spectroscopy (at room temperature), spectral (at liquid nitrogen temperature) and colour cathodoluminescence and laser induced photoluminescence. Among the studied samples there are several octahedral natural diamond crystals, synthetic diamond crystals, flat plates cut from natural and synthetic diamonds, and also treated black diamonds and natural black diamonds. Several samples (natural octahedral diamond crystals) have undergone annealing at temperatures of 1700-1800 °C under high pressure (6 GPa) and some samples (octahedral natural diamond crystals, natural and synthetic diamond flat plates) were irradiated by different types of radiation such as protons, gamma, and electron. Irradiated samples then were annealed at different temperatures in the range of 800-900 °C. At every stage spectroscopic data were acquired.

The colour of the irradiated samples has changed to green for natural diamonds and to greenish-yellow for synthetic diamonds. In the absorption spectra of the irradiated samples the line at 503 nm appeared (H3-center). Images of the colour cathodoluminescence of the irradiated natural diamond samples revealed no changing of colour and distribution of luminescence (remain blue), but the intensity seems to be weaker. Images of the colour cathodoluminescence of the irradiated synthetic diamond samples revealed changing of the intensity of luminescence, i.e. a weakening of red cathodoluminescence.

Interpretation of acquired data allows to model the structure of some lattice defects in diamond and also provides a useful information on mechanisms of the transformation and stability of lattice defects in diamonds and causes of diamond colour.