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FORMATION OF GE-V CENTERS IN VARIOUS CVD DIAMOND MATERIALS: SINGLE-CRYSTALS, POLYCRYSTALLINE FILMS AND NANOPARTICLES

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Germanium-Vacancy (Ge-V) color center in diamond possesses a narrow band photoluminescence (PL) emission in orange spectral range interesting as a single-photon source for quantum optical technologies and thermometry, therefore, the development of methods for controllable doping of diamond with Ge is of high importance for such applications [1,2].

Here, we report on the growth of various Ge-doped diamond materials using microwave plasma chemical vapor deposition (CVD, reactor ARDIS-100, 2.45 GHz) by adding the germane (GeH_4) gas to CH_4-H_2 mixtures. The obtained materials included epitaxial Ge-doped diamond layers, micro- and nanocrystalline diamond films (MCD and NCD, accordingly; see similar research for Si-V centers in [3]), and individual micro- and nanoparticles. The polycrystalline films and separate particles were deposited on Si and AlN substrates, the epitaxial diamond was grown on Ib and IIa HPHT diamond substrates. The results of our investigation of the Ge-V peak intensity at the wavelength of 602 nm in the PL spectra taken both at room and liquid helium (4 K) temperatures will be reported (for Ge-doped thick MCD film – see Fig. 1). The data on diamond morphology, growth rate, Raman spectra and Ge-V PL and optical absorption for all types of samples will be compared.

In summary, the *in situ* doping of diamond with Ge from GeH_4 gas added in microwave plasma is promising to be a convenient way to control Ge-V abundance and PL emission, similarly to the diamond doping from silane [3].

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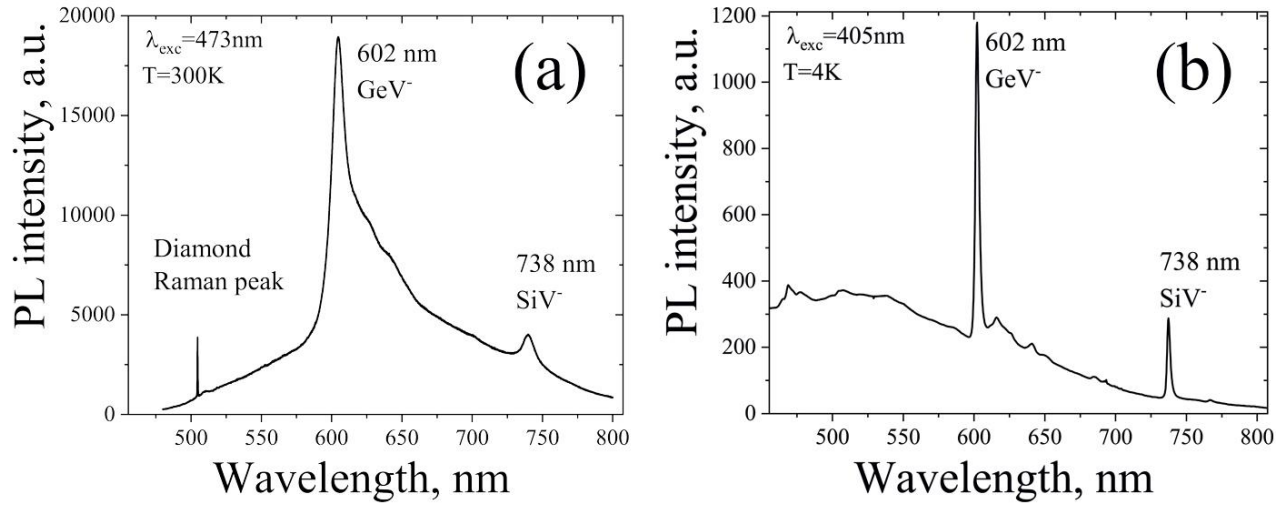

Fig.1. PL spectra of CVD-grown Ge-doped 100 μm thick MCD film at room temperature (a) and at 4 K (b).

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