

Laser-induced Frenkel interstitial-vacancy pairs in diamond: Life in couple or apart?

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As is known, ultrashort laser pulses generate the Frenkel interstitial vacancy pairs (IVPs) due to the strain-potential self-trapping of hot nondegenerate electrons and (or) holes. Dynamic electronic and phonon-induced bandgap renormalization, transient stress fields and IVP concentration gradients could induce their intense transport and self-organization in the host lattice, separating interstitials and vacancies according to their charge state and specific deformation of the lattice. Moreover, the chemical and (or) structural interactions of non-equilibrium interstitials and vacancies with other lattice chemical impurities, e.g., different nitrogen clusters in natural and synthetic diamonds, could result in their disbalance and separate accumulation, giving rise to the following important implications (fracture and graphitization, platelets, plastic deformation etc) produced by ultrashort laser pulses in bulk diamonds. This research was supported by the Russian Science Foundation (project No. 21-79-30063).