

Creation of nanosize defects in LiF crystals under 5- and 10-MeV Au ion irradiation at room temperature

Lushchik A, Lushchik Ch, Schwartz K, Vasil'chenko E, Papaleo R, Sorokin M, Volkov AE, Neumann R, Trautmann C

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Investigation of radiation defects induced by the irradiation of LiF crystals with 5- or 10-MeV Au ions (fluences of 10^{11} – 2×10^{14} ions/cm²; flux varies by 2 orders of magnitude) at room temperature has been performed using the methods of optical absorption and high-temperature (400–750 K) thermoactivation spectroscopy. The creation efficiency of color centers (F , F_2 , F_3 , . . .) and colloids drastically depends on both the fluence and ion flux (beam current). Besides impurity (magnesium) colloids with the absorption band peaked at 4.4–4.6 eV, the broad absorption band at 2.3–3.3 eV related to intrinsic Li colloids is reliably distinguished. The creation efficiency of Li colloids by 5-MeV Au ions is lower than that by 10-MeV ions, which form δ electrons with higher energies sufficient for the creation of cation excitons (~62 eV). The cation exciton decays, in turn, with the formation of a group of spatially close F centers. At a high ion flux, the next bombarding ions hit the same crystal region with a small time delay (10–100 s) and also form, after similar intermediate processes, the groups of F centers that participate in the formation of stable agglomerates of several F_3 or even more complex centers, which serve as stable (up to 620 K) seeds for nanosize Li colloids. The peculiarities of the formation, enlargement, and annealing of intrinsic colloids in LiF crystals are considered, invoking a formal analog with the processes in photographic materials based on silver halides.