Irradiation induced nanostructures in LiF crystals and possible applications

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Lithium flouride crystals with simple ionic binding and a large band gap (14.6 eV) played an important role on understanding of radiation damage processes in dielectric materials [1 – 4]. A detailed study of heavy ion irradiation in LiF crystals (from ^{4}He up to ^{238}U) shows that after creation of single Frenkel pairs ((*F*-*H*) and (*α*–*I*)) the concentration of single F centers saturates ($N_F \approx 10^{19}$ cm^{-3}) and at higher absorbed energy (fluences) complex color centers F_n and larger aggregates (dislocation loops, vacancy and fluorine clusters, colloids etc.) are produced [1-3]. The formation of nanodefects depends on density of the absorbed energy and/or ion energy loss (dE/dx). The nanodefects are produced both in single ion tracks (above the threshold of dE/dx) as well us under of ion track overlapping. Irradiation with heavy ions leads to a large absorbed energy in the central part of the track (core) with a strong gradient of the absorbed energy and defect concentration around the ion path (halo). At high absorbed energy the concentration of nanodefects is comparable to the concentration of color centers [1-3]. Nanoclusters are observed also under ion induced sputtering [5]. The role of self-trapped holes during the electron-hole relaxation in ion tracks in LiF crystals is analyzed [4]. Applications of color centers and nanoclusters are discussed [6].

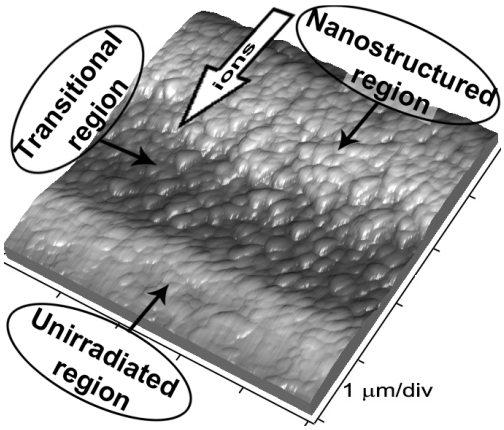

Fig.1. AFM image of nano-crystallites in LiF sample irradiated with 15 MeV Au ions at fluence 5x10^{13} Au/cm^2 after chemical etching.

References

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