Nanostructuring and hardening of LiF crystals irradiated with 3–15 MeV Au ions

Maniks J, Manika I, Grants R, Zabels R, Schwartz K, Sorokin M, Papaleo RM
Applied Physics A 104 (2011) 1121–1128

Modifications of the structure and mechanical properties in LiF crystals irradiated with MeV-energy Au ions have been studied using nanoindentation, atomic force microscopy and optical spectroscopy. The nanostructuring of crystals under a high-fluence irradiation (above 10^{13} ions/cm^2) was observed. Nanoindentation tests show a strong ion-induced increase of hardness (up to 150–200%), which is related to the high volume concentration of complex color centers, defect aggregates, dislocation loops and grain boundaries acting as strong barriers for dislocations. From the depth profiling of the hardness and energy loss it follows that both nuclear and electronic stopping mechanisms of MeV Au ions contribute to the creation of damage and hardening. Whereas the electronic stopping is dominating in the near-surface region, the effect of elastic displacements prevails in deeper layers close to the projectile range