Energy loss and fluence dependency of swift-ion-induced hardening in LiF

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The depth profiles of the hardening effects of LiF irradiated with swift Au, Pb, Bi, Kr, Ni and S ions of MeV-GeV energy have been studied as a function of ion penetration depth. For all projectiles, the hardness increases scaling with the range of ions and depending on ion fluence and energy loss. Heavy ions (Au, Pb, Bi), for which the energy loss noticeably exceeds the threshold of about 10 keV/nm for severe track core damage, cause uniform increase of hardness in the entire irradiated layer. For irradiations with lighter S, Ni, Kr ions, the hardening displays strong depth dependence. Ion-induced hardening is related to pinning of dislocations by defect aggregates (possibly small Li colloids, vacancy clusters and bubbles of molecular fluorine) created along ion tracks or formed by saturation and aggregation of single defects when neighbour track overlapping occurs.