

## Characterization of swift heavy ion tracks in CaF<sub>2</sub> by scanning force and transmission electron microscopy

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Single crystals of fluorite (CaF<sub>2</sub>) were exposed to various swift heavy ions (Ca up to U) of energy 1-11.1 MeV per nucleon, covering a large range of electronic stopping power  $S_e$  between 4.6 and 35.5 keV/nm. The irradiated (1 1 1) cleaved surfaces were investigated by means of scanning force microscopy in tapping mode. Nanometric hillocks produced by the ion projectiles were analyzed in terms of creation efficiency  $E_{eff}$ , diameter and height values, and diameter-height correlation. Hillock formation appears with a low efficiency above a  $S_e$  threshold of  $\sim 5$  keV/nm. The mean height of these hillocks is approximately constant ( $\sim 1$  nm) between 5 and 10 keV/nm and increases linearly with  $S_e$  above 10 keV/nm reaching 12.5 nm for the largest  $S_e$  value investigated. Similarly, the efficiency grows versus  $S_e$  achieving 100% for  $S_e > 13$  keV/nm where each projectile produces an individual hillock. Above 13 keV/nm, the hillock height and diameter are strongly correlated. The diameter was deduced by graphical deconvolution of the scanning-tip curvature that is determined experimentally for each set of measurements. In the entire  $S_e$  regime, the mean diameter exhibits a constant value of similar to 13 nm, which is significantly larger than 6 nm wide tracks observed by transmission electron microscopy.