MeV gold irradiation induced damage in α-quartz: Competition between nuclear and electronic stopping

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Damage creation in crystalline α-quartz by irradiation is studied using gold ions of energies between 0.5 and 10 MeV. For all ions, the total stopping power $(dE/dx)_{tot}$ has a value of about 4.5 keV/nm, whereas the contribution of the electronic stopping power ranges from 0.93 keV/nm at 0.5 MeV to 3.6 keV/nm at 10 MeV. This variation allows us to test which role the nuclear acid the electronic collisions plays for the damage processes. The kinetic of the ion induced damage was determined by channeling RBS and the volume increase by profilometry. Single ion impacts create damage when electronic stopping dominates, while several impacts are necessary to achieve damage in the nuclear stopping regime. A detailed analysis allows us to deduce the damage cross-sections of the two processes. The electronic stopping power of damage creation appears above an electronic dE/dx threshold of 1.4 ± 0.3 keV/nm.