Cratering by MeV-GeV ions as a function of angle of incidence

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We report on a systematic scanning force microscope study of crater formation induced by swift heavy ions as a function of angle of incidence. PMMA films were bombarded with ^{197}Au (20 MeV), ^{209}Bi (2320 MeV) and ^{238}U (2640 MeV) ions at angles θ varying from 0° to 84° to the surface normal. In all cases, the length of the craters as well as rim height and length scale with $(\cos\theta)^{-1}$. Crater width showed a much weaker $(\cos\theta)^{-0.3}$ dependence. Similar angular dependences were observed for the different ion species and energies used. The experimental data is compared to molecular dynamics simulations of crater formation in a model solid. The simulations show a $(\cos\theta)^{-1}$ dependence for the crater length, but no dependence for the crater width, unless a wide initial track of excitation is used.