Ultrahigh vacuum atomic force microscopy investigation of nanoablation from insulator surfaces by slow multicharged ions

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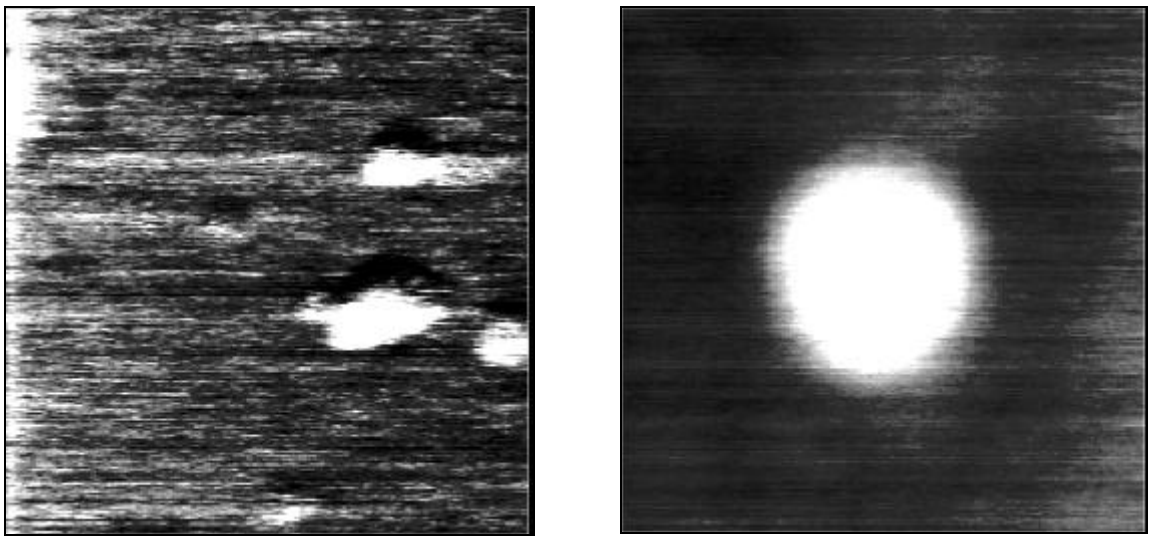
Slow multicharged ions impinging on specific insulator surfaces cause considerably more efficient ablation than attributable to common kinetic sputtering. So far, strong evidence for q-dependent potential sputtering has been acquired by bombarding thin polycrystalline films of alkalihalides (LiF, NaCl), Al_2O_3 and SiO_2 [1] with various multicharged ion (MCI) species. The underlying "potential sputtering" (PS) process was related to defect-mediated desorption [2].

For single ion impacts on monocrystalline insulator surfaces, ultrahigh vacuum atomic force microscopy (UHV AFM, Omicron NanoTechnology, Germany) reveals highly localized nanodefects.

Surfaces investigated comprised LiF (100), SiO_2 (0001) α-quartz, muscovite mica and sapphire c-plane Al_2O_3 (0001). Ion bombardment (ion dose typically 10^{12} ions/cm^2) was accompanied by electron flooding to compensate for surface charge-up. Target samples were transferred in a transportable UHV vault between bombardment chamber and UHV AFM, which keeps target samples under permanent UHV conditions and drastically reduces AFM system noise.

The such produced nanostructures show distinctively q-dependent features in lateral and vertical directions. So far, this proves the importance of PS also for monocrystalline insulator surfaces. Efforts for detailed explanation of these MCI induced nanostructures are under way.



1.2 keV Ar^+ (left) and Ar^{7+} (right) → Al_2O_3 (0001); 200∗200 nm^2

Work supported by Austrian FWF (project no. 13543-PHY).

[1] T. Neidhart *et al.*, Phys. Rev. Lett. **74** (1995) 5280; M. Sporn *et al.*, Phys. Rev. Lett. **79** (1997) 945; G. Hayderer *et al.*, Phys. Rev. Lett. **83** (1999) 3948.
[2] F. Aumayr *et al.*, Comments. At. Mol. Phys. **34** (1999) 201.