TU WIEN

Institut für Allgemeine Physik - Vienna University of Technology

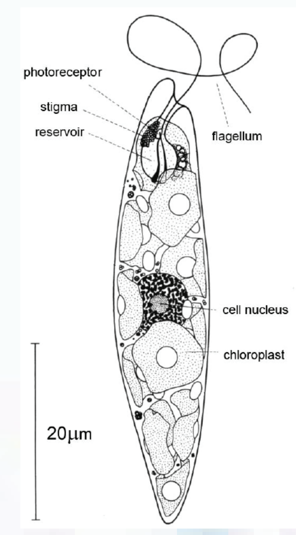
AFM research at the IAP of the Vienna University of Technology

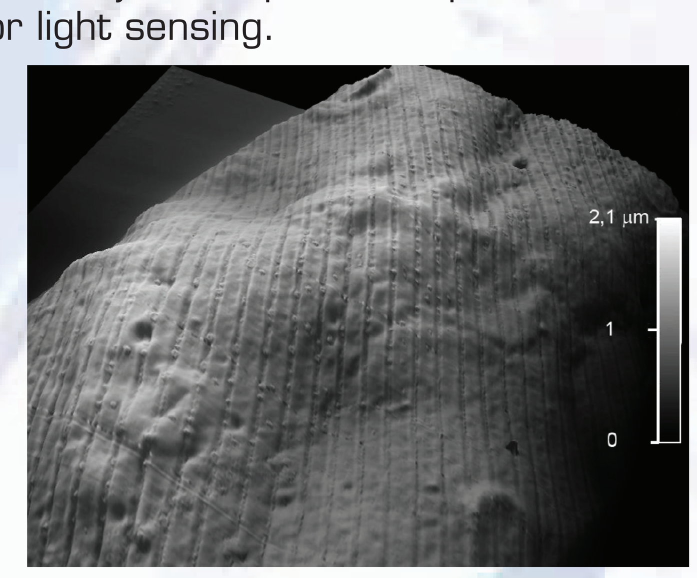
R. Ritter, C. Gruenberger, A.S. El-Said, W. Meissl, O. Hekele, C. Goesselsberger, F. Aumayr and I.C. Gebeshuber

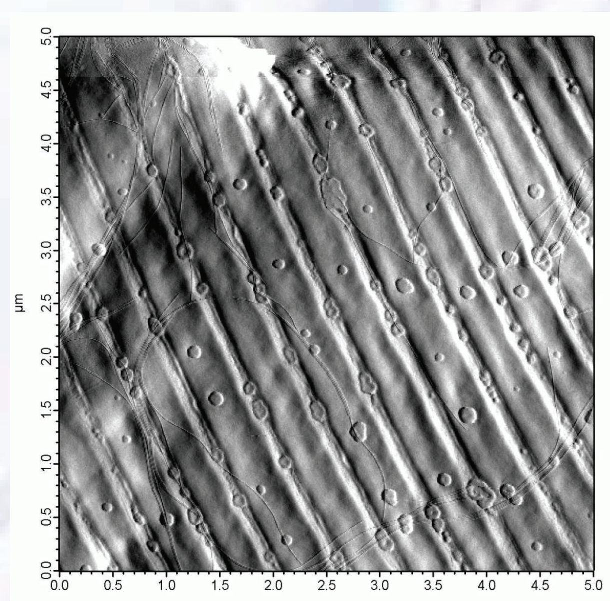
Institut für Allgemeine Physik, Vienna University of Technology, Wiedner Hauptstrasse 8-10/134, 1040 Wien, Austria
email: e0126455@stud3.tuwien.ac.at

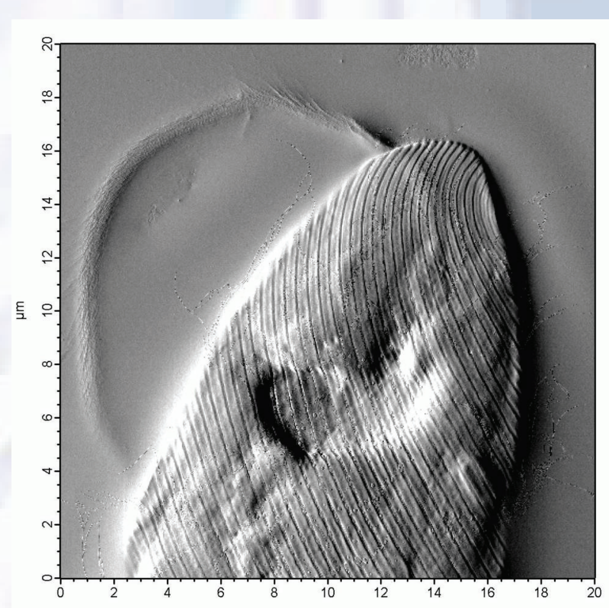
Euglena gracilis

Euglena gracilis is a single-celled algal species with a typical length between 20µm and 100µm.
E. gracilis is a very compact organism and uses efficient functional organelles for sensing the environment and reacting to it, converting and storing energy and metabolizing nutrients.
E. gracilis has interesting material properties: a tough and yet flexible cell wall (pellicle), dense semicrystalline deposits serving for energy storage and other various components with highly ordered molecular structures such as a monocrystalline photoreceptor that is used for light sensing.



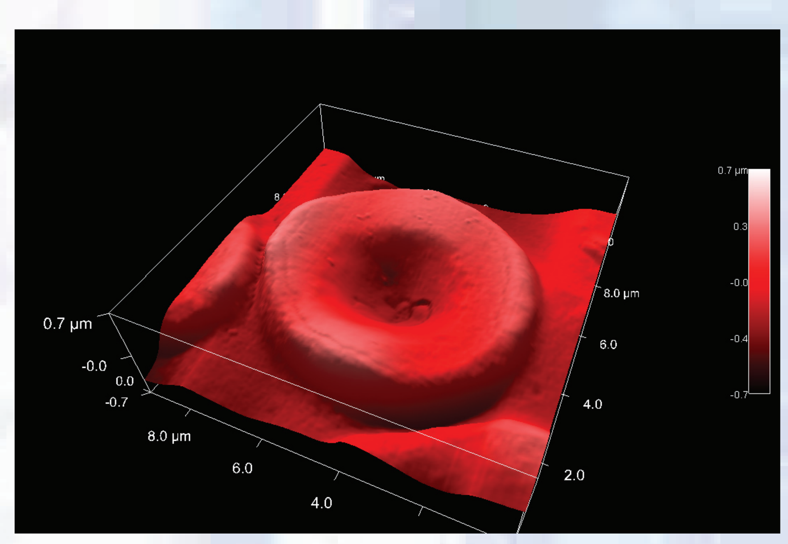


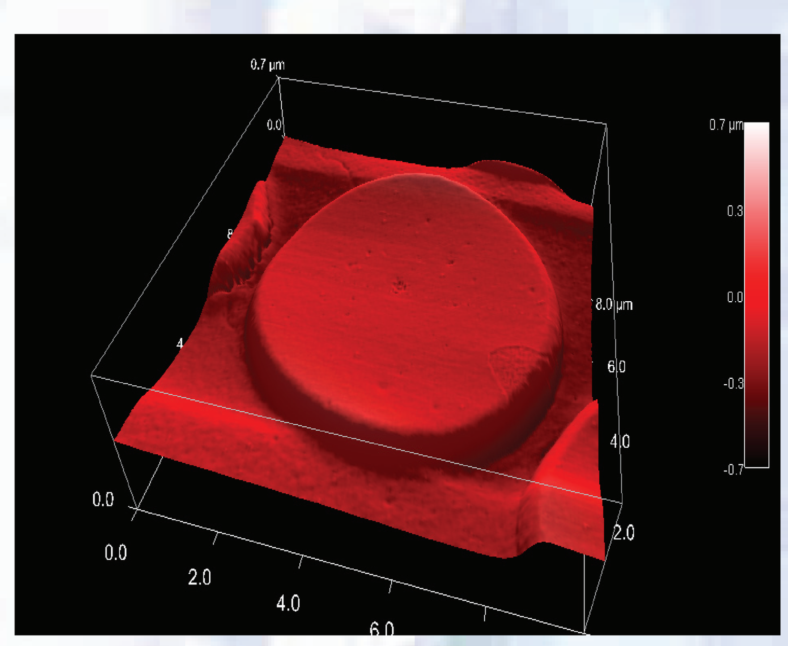


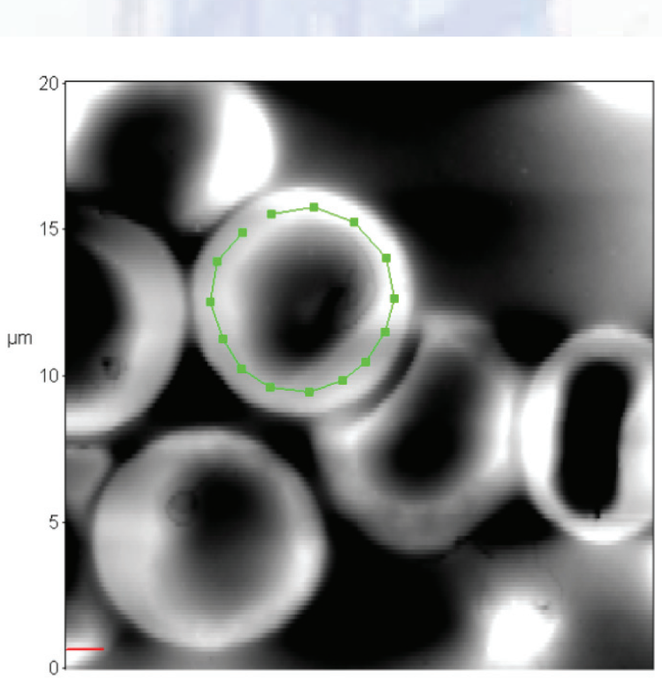


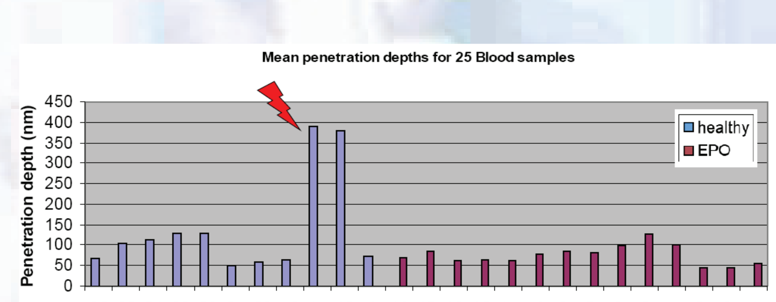
Red blood cells

Atomic force spectroscopy with a trigger force of 3uN of smears of red blood cells on glass slides of erythropoietin doped patients and undoped patients shows no difference concerning parametres such as topography, stiffness, penetration depth and elasticity.
Interestingly enough, the sample of one specific patient had cells where the penetration depth was found to be four times as large as in the healthy control group.
Further medical investigation revealed a rare type of diabetes in the donor of that sample.





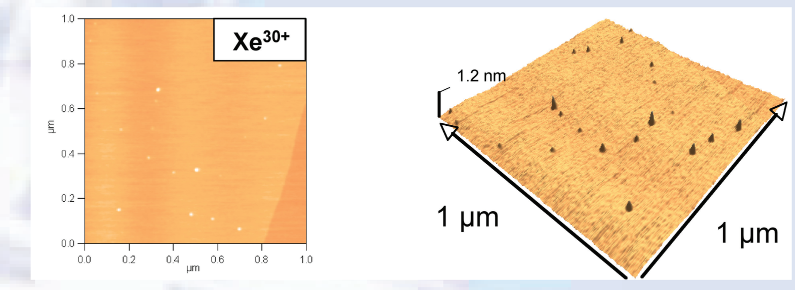


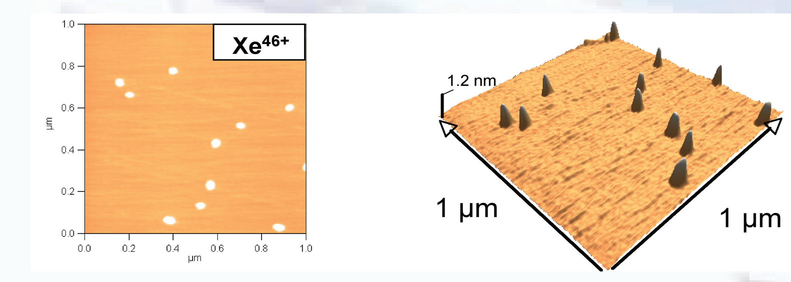


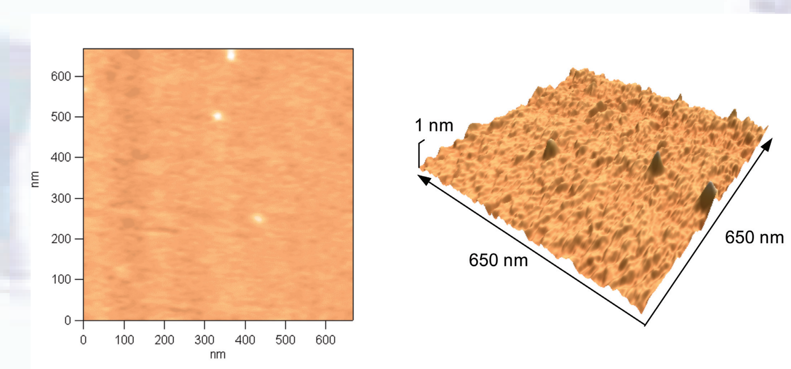
Part of this work was initiated by P. Varga. We thank W. Rupp for his support during the MFM measurements.

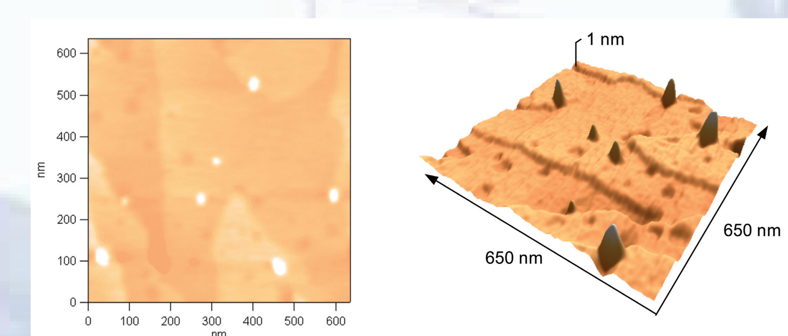
Irradiation with highly charged ions

Irradiation of crystalline solid targets with fast heavy ions can lead to severe structural modifications at the surface and in the bulk. Examples are the formation of latent tracks in the solid, the creation of nanostructures on the surface, and the occurrence of phase transitions.
Highly charged ions (HCI) carry a large amount of potential energy,which is equal to the total ionization energy.
Upon interaction with solid surfaces the HCI deposit their potential energy within a very short time (a few femtoseconds) within a nanometer size volume close to the surface.
Hillock-like surface nanostructures on CaF_2 single crystals can not only be produced by swift heavy ions but also by slow HCI, as long as these ions are sufficiently highly charged.
Investigations on LiF(100) show that, similar to the case of CaF_2(111) the size (i.e. height and diameter) of the hillocks increases considerably with increasing charge state. The number of hillocks per unit area was found to be in good agreement with the applied ion fluence, i.e., above a certain threshold, the majority of projectiles produce an individual hillock each.



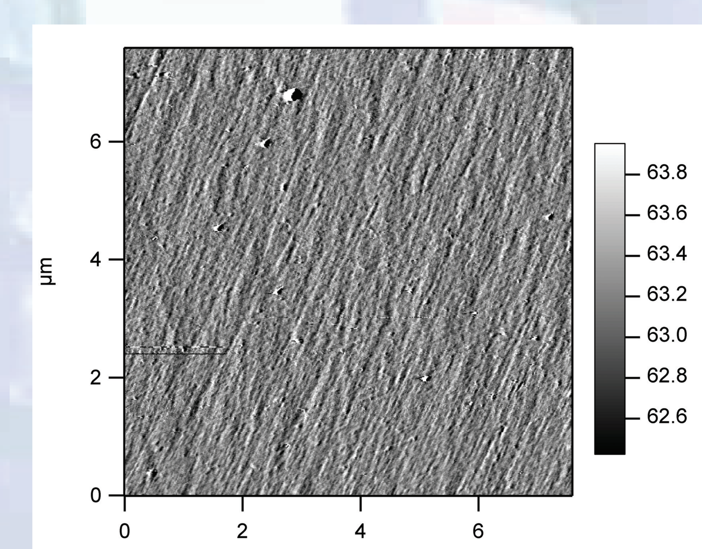


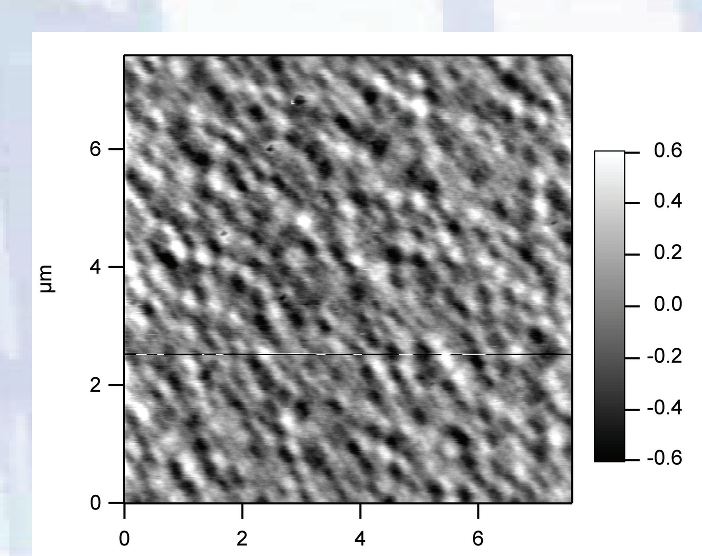


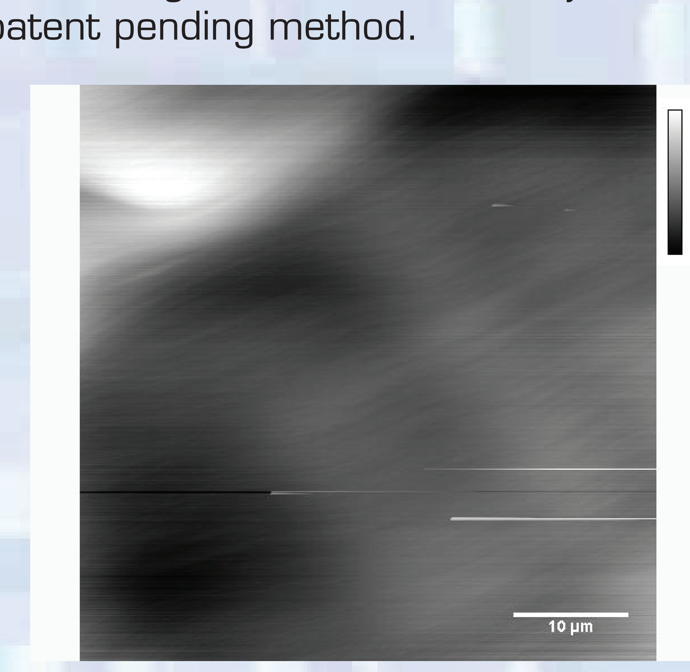


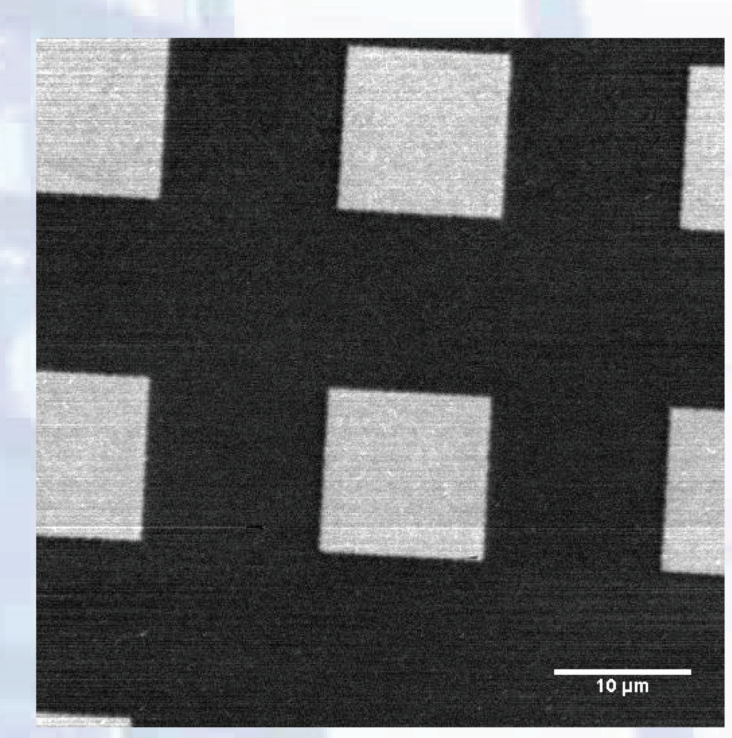
Magnetic force measurements

By means of magnetic force microscopy the magnetic properties of surfaces, e.g. magnetic storage devices such as hard disks, floppy disks and zip disks, can be probed.
The technique is as follows:
For odd scanlines, the cantilever hovers some nanometres (typically 50 - 100nm) higher than for topographical scanning.
The comparison of phase trace and height information clearly shows that the imaged forces arise exclusively from the interaction of the tip's magnetic moment and the sample's magnetic field and have no topographic origin.
Ongoing projects involve MFM in order to determine whether or not highly ordered pyrolitic graphite can be magnetised by irradiation with highly charged ions. Furthermore, this technique shall be used to investigate the possibility of magnetic structuring on the nanoscale by a novel , patent pending method.









References

Gruenberger C., Ritter R., Aumayr F., Stachelberger H. and Gebeshuber I.C. (2007) Algal biophysics: Euglena gracilis investigated by atomic force microscopy, Mat. Sci. Forum 555, 411-416, in press

El-Said A.S., Meissl W., Simon M.C., Crespo López-Urrutia J.R., Gebeshuber I.C., Lang M., Winter HP., Ullrich J. and Aumayr F. (2007) "Surface nanostructures induced by slow highly charged ions on CaF2 single crystals",Nucl. Instr. Meth. Phys. Res. B 256, 346-349, doi:10.1016/j.nimb.2006.12.140

poster design by F. A.