Motivation

Detailed knowledge about the contact charging of dielectric materials is of great interest for technological applications like tribocharging separation\(^{1,12}\) of mineral particles. The underlying mechanisms are still not well understood\(^8\). So far, AFM based charging investigations were just performed on dielectric thin layers.\(^{4,14}\)

Here, an attempt is made to study the electric charging of well-defined surfaces (calcite monocrystals) upon contact with a conductive AFM tip. Kelvin probe force microscopy (KPFM)\(^7\) was applied to verify the electrostatic characteristic of the surfaces before and after contact charging. Both, tribocharging due to rubbing and static contact charging with applied tip bias have been investigated.

Experimental

**Equipment:**

- Asylum Research MFP-3D AFM
- TiN coated tips for monocrystalline calcite, CaCO\(_3\) (100), MTI Corporation, USA

**Probes:**

- a prototype of the coaxial triboelectrostatic separator\(^4\)

**Samples:**

- monocrystalline calcite, CaCO\(_3\) (100), MTI Corporation, USA

**Conditions:**

- air, room temperature, 50 % r.H., applied forces: 2-3 µF, applied voltage: ±10 V

**Measurement procedure:**

- KPFM measurements before charging
- charging (rubbing or static contact) measurements repeating

Results

**Static charging**

The AFM tip with applied bias (±10 V) is brought into contact with a defined force (~2 µN) and for defined time (15 min).

**Rubbing**

The AFM tip with or without applied bias (0 V or ±10 V) is dragged on a chosen surface area (4 x 4 µm\(^2\)) with defined force (~3 µN) and speed (0.30 Hz).

Conclusion

- Successful charging by static contact as well as by rubbing is confirmed by CPD change.
- The resulting surface charge depends on:
  - the type of charging (static charging, rubbing),
  - the value of the initial surface potential.
- Charging can be reversed by application of opposite tip bias.
- Charge decays roughly exponentially with time.

Literature

[5] H. Sun, H. Chu, J. Wang, L. Ding, and Y. Li,

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Outlook

Performing contact charging with crystal particle attached to the AFM cantilever.