Physico-Chemical Properties of Alkali Halide Surfaces
—frictional anisotropy and asymmetry studied with FFM—

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Summary

Literature data on frictional anisotropy([100] vs. [110] directions) on the surfaces of alkali halide crystals were often in discrepancy. It is probably because bulk properties are inter-mixed with surface properties in conventional experiments with high loads using scratch testors. We have measured frictional coefficients of (001) surfaces of NaCl, KCl, NaF, LiF, and MgO using Frictional Force Microscopy(FFM). Due to much smaller normal loads(10^{-9}-10^{-7} N), only the surface property was detected.

In order to check the functions of adsorbed water, dependence of the friction upon relative humidity(RH) was studied first. The frictional coefficients of fairly water soluble NaCl decreased at higher RH indicating lubrication effect of adsorbed water. No RH dependence was observed with LiF and MgO which are almost insoluble in water. NaF and KCl which have smaller solubility compared to NaCl showed RH dependence only at >*ca.* 50% RH. In less humid conditions (RH<40%), all the materials showed much smaller friction upon scanning the probe in [110] direction rather than in [100] direction.

In order to explain the frictional anisotropy, interaction potentials between the electric dipole of the probe and the electric charges of the ions at the surface were calculated. The oscillation amplitudes of the potential were much bigger along the [100] direction than along the [110] direction. Fairly good correlation was recognized between the ratio of frictional coeffecients $F_{[100]}/F_{[110]}$ and the ratio of the potential gradients $f_{[100]}/f_{[110]}$. The frictional anisotropy is semi-quantitatively explained by the Coulombic interaction potential.

At CaSO4(100) surface, the S-O bonds are pointing the same direction all over the surface. In this case, the directionality of the surface was clearly detected as an asymmetry component of the friction.