Physico-Chemical Properties of Alkali Halide Surfaces

—Frictional force microscopic study of effects of adsorbed water upon friction and atomic force microscopic study of thermal step dynamics on NaCl(001)—

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Summary

1. Effects of adsorbed water upon friction

Our previous observation of frictional anisotropy([100] vs. [110] directions) at alkali halide (001) surfaces also showed lubrication effect by water with more water-soluble crystals. However, higher friction due to adhesion by water has often been reported with other materials with rough surfaces. We have studied the two opposite effects using atom-flat cleavage surfaces, with different levels of affinity with water, of layered $K_4Nb_6O_{17}\cdot 3H_2O$.

With relative humidity(RH) higher than 30%, wet surface-I clearly showed less friction compared to dry surface-II. Friction decreased toward higher RH, indicating lubrication. With RH<30%, however, friction increased with RH with both surfaces, indicating adhesion effect. Even with atom-flat surfaces, both effects are observed depending upon material and RH. All wet surfaces show lubrication effect. Partly wet surfaces show stronger friction due to repeated adhesion, causing oscillation in probe-surface interaction potentials.

2. Thermal step dynamics at NaCl(001)

Atomic force microscopic images of NaCl(001) were recorded before and after heat treatment at various temperatures. The same part was observed repeatedly. At 450℃, island terraces at highest parts started shrinking, while at lower parts, smoothly curved steps got segmented into straight lines, indicating strong anisotropy in step energy. At 500℃, steps became smoother showing decrease in the anisotropy. At 600℃, multi-atomic steps decomposed into monatomic steps, indicating disapearance of facets. At 650℃, the steps took more complex shapes, indicating much lower step energy. The surface became smoother in three dimension. At 700℃, the surface is thoroughly roughened.