A contribution to the implication of surface properties of cassiterite in flotation: The influence of crystallographic orientation of cassiterite on its surface potential

Haosheng Wu[1], Christian Weber[2], Martin Rudolph[1]

1) *Helmholtz Institute Freiberg for Resource Technology (HIF), Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Chemnitzer Str. 40, 09599 Freiberg, Germany;*
2) *Technical University of Freiberg, Institute of Mechanical Process Engineering and Mineral Processing, Agricolastraße1, 09599 Freiberg, Germany*

Atomic force microscopy (AFM) with the colloidal probe and needle-type topography techniques were employed. The high-resolution force spectroscopy measurements were explored between a silica sphere (non-functionalized or hydrophobized) attached to a tip-less contact-mode AFM cantilever and the cassiterite surfaces: (110), (100) and (001) in aqueous solution. Isoelectric point (IEP) of SnO_2(100) was found to be within 4.1- 4.8, SnO_2(001) within 4.8-5.4, while SnO_2(110) within 5.4-6.2. Differences in surface potential as a function of orientation at pH 3 are calculated based on DLVO theory with the assumption of constant potential on both of the SnO_2 and SiO_2 surface. The calculated surface potentials of (100), (001) and (110) are 2.49 mV, 2.50 mV and 6.31 mV with the silica surface potential being -29.60 mV.

This phenomenon was discussed in terms of differences in both the coordination number and density of cationic and anionic sites on the surface. It is believed to play an important role between the interaction of collectors and cassiterite (SnO_2) and lead to different adsorption behaviour of collectors depending on their sensibility of electrostatic force (see Fig.1).

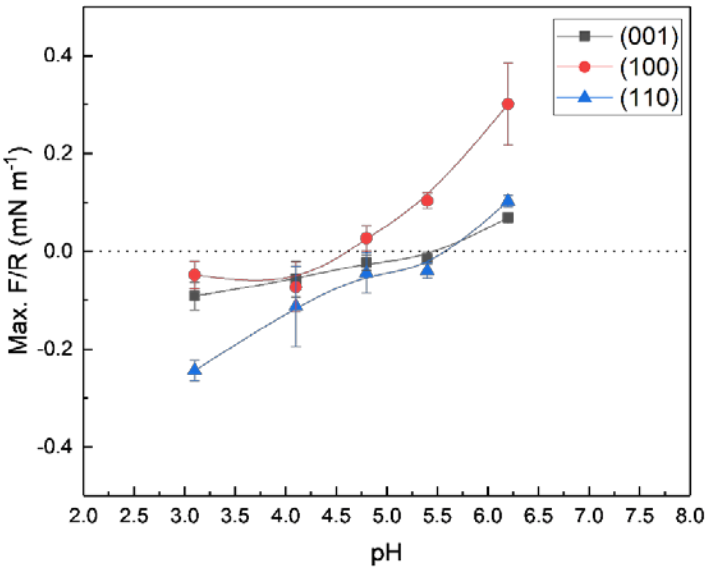

Figure 1. Normalized maximal double-layer Force F/R (mN N^{-1}) between (110), (100) and (001) cassiterite surfaces and silica spherical tip in 1 mM L^{-1} KCl solution as a function of the solution pH.

For a proof of concept, we used sulfosuccinamate (Aerosol® 22) as collector for cassiterite flotation to functionalize different cassiterite surfaces at pH 3. The contact angle measurements as well as the topography visualizations from AFM showed that the adsorption of Aerosol® 22 is the most abundant on SnO_2(110) followed by SnO_2(100) and SnO_2(001) in the concentration range from 10^{-6} M to 10^{-4} M at pH 3.
In this paper, it is concluded that large IEP difference is between the most common cleavage surfaces of cassiterite: (100) and (110). This IEP difference of different orientations of cassiterite is a crucial factor for the adsorption behaviour between collector and cassiterite.