Surface properties of nanosize oxides by high temperature electrophoresis

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Surface properties – zeta potential and isoelectric point (IEP) – of SnO_2 and SiO_2 were studied over the temperature range from 25 to 260°C. Two illumination approaches (i.e., bright- and dark-field) were used to obtain the high-temperature electrophoretic mobility; both using a specially designed hydrothermal electrophoresis cell [1, 2]. Bright-field illumination worked better for large particles, while dark-field illumination provided increased particle size detection down to the nanometer range, as well as more accurate measurements close to the IEP. Nanometer detection was possible by observing the light reflected from the particles' surface instead of tracking the particles themselves.

The electrophoretic mobility of SnO_2 was measured over the pH range 2 to 12, and the pH value corresponding to zero zeta potential (IEP) was determined at each temperature. In the case of SiO_2, the surface was always negatively charged at all temperatures thus no IEPs were observed. The obtained IEP values for SnO_2 were fitted to the 1*p*K surface complexation model, as well as compared to the values of the pH points of zero charge (PZC) predicted by the Multisite Complexation (MUSIC) model for this material.

The temperature dependence of the IEP values of SnO_2 closely follows the trend of temperature change of the water dissociation constant. A similar surface behavior has been observed for other oxides [1,3]; furthermore, this trend may provide an empirical tool for predicting surface properties of oxides at elevated temperatures.

[1] Zhou *et al.* (2003) *Rev. Sci. Instr.*, **74**, 2501-2506.
[2] Fedkin *et al.* (2003) *Langmuir*, **19**, 3797-3804.
[3] Machesky *et al.* (2001) *J. Colloid Int. Sci.*, **200**, 298-309.

Integrated modelling of biological and weathering processes at the continental scale

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Continental weathering is a key process of the surficial biogeochemical cycles at the geological timescale, and is generally modelled as a function of global climate through simple parametric laws. However, recent evidences for rapid changes in continental weathering at the decennial to centenial scale in response to the ongoing global climatic change ask for the development of mechanistic models coupling the fast responding continental biospheric processes to the weathering reactions.

Here we present the coupling of the LPJ global biospheric model to a reactive transport model of the weathering reactions in the field (WITCH). The coupled LPJ-WITCH model runs with a spatial resolution of 0.5°lat x 0.5°long, and is forced by database output supplying the mean annual rainwater flux and chemistry, the air temperature, the bedrock lithology, and the soil characteristics. The model is run over the Orinoco watershed, and its main output are the main base cation composition of the runoff and drainage waters (thus the CO_2 consumption), which compares reasonably well with the available measurements in the main stream.

Sensitivity studies to global climate and land use changes are performed, illustrating the efficiency of such large scale mechanistic models. Also a sensitivity test to increased erosion rate is performed when tropical forest is replaced by grasslands, by reducing the thickness of the soil layer.