TOBIAS LOPIAN

will present his Ph.D. dissertation

Characterization of a metal-extracting water-poor microemulsion

The defense will take place on **Monday, November 20, 2017** at **10.00 am**

in the ICSM Auditorium

Recycling of rare earths from electronic waste has still not found a significant industrial realization. One reason is the lack of optimized separation procedures due to poor fundamental knowledge on these systems. Due to the chemical and physical similarities of these metals, designing an efficient, adaptive and predictive formulation is still out of scope of possibilities. The supramolecular interpretation of complex-formation in the organic phase has gained an increasing importance in the last years. It is the most promising approach allowing the explanation of diverse phenomena, such as third phase formation and strong signals in small scattering experiments and to revert to methods well known from surfactant science. Our contribution towards a more complete understanding in this matter is the analysis of the electrodynamic behaviour of such phases and the correlation of these findings with the results of self-assembly properties and mass transport in these media.

For this study, we specifically designed a reference model, breaking an extraction process down to its four fundamental components: The extractant before extraction (Di-(2-ethylhexyl)phosphoric acid, HDEHP), the extractant after extraction (its sodium salt, NaDEHP), toluene as apolar diluent and water. A Gibbs phase prism has been prepared (illustrated in Figure 1), where the z-axis gives the ratio of HDEHP to NaDEHP, representing the development of an extraction. Covering the low frequency-domain, impedance spectroscopy has been the method of choice in order to determine the frequency-dependent conductivity. Using dielectric relaxation spectroscopy, we reveal fast dynamic processes at high frequencies. Combined SAXS and SANS measurements have been performed to compare the electrodynamic trends with aggregation properties and intercluster interactions.

Two phenomena have been identified to be responsible for the conductivity profile in reverse micellar systems: the formation of charged aggregates through dismutation and percolation. Throughout the reference system, these two processes have been probed as function of three variables: total extractant concentration, the water-to-surfactant ratio and the Na:H-ratio. As a major result, water plays a significant role in both processes. In case of percolation, reverse aggregates are not able to merge in the absence of water. Therefore, electrical conductivity is prohibited. In dilute systems, water facilitates the dismutation–process leading to an increase in conductivity.

Keywords: Solvent extraction; Microemulsion; Colloidal approach; Phase diagrams; Conductivity; Small-angle scattering