**In the curl: Interface-mediated formation of polymer/mineral composite micro scrolls**

*Viktoria Gruen1, Nicolas Helfricht2, Sabine Rosenfeldt3, Anna Schenk1*

1Physical Chemistry – Colloidal Systems, University of Bayreuth, Bayreuth, Germany; 2Physical Chemistry II, University of Bayreuth, Bayreuth, Germany; 3Physical Chemistry I, University of Bayreuth, Bayreuth, Germany

Introduction.

Nature’s dexterity in using organic matrices to generate bio-inorganic hybrid materials such as corals, bones and mollusc shells is unique. These composites have incomparable properties and their astonishing degree of structural organization remains unmatched in synthetic systems. Substantial progress has been made in recent years in translating key concepts of biological mineralization into artificial materials, which holds enormous potential for the development of low-temperature routes towards functional materials such as spinel-type Co3O4, a semiconductor with a wide range of applications in clean energy conversion.

Aims.

We here explore a bio-inspired approach, in which a cobalt(II) hydroxide carbonate precursor with layered crystallographic structure is precipitated from aqueous solution in the presence of synthetic polyelectrolytes, acting as mimics of the soluble structure-directing matrix associated with biological mineralization processes. Calcination leads to a pseudomorphic transformation of the precursors into the functional cobalt(II,III) oxide phase, which opens exciting possibilities to generate compact microelectrodes for water-splitting based on controlled crystallization and self-rolling mechanisms.

Results and Discussion.

We demonstrate that extended mineral sheets can be formed at the air-solution interface when precipitation occurs via slow gas diffusion at room temperature. (Schenk *et al.* 2017) Intriguingly, the film fragments isolated after drying characteristically show bent and even curled morphologies. While the phenomenon of curled morphologies is well-documented in biological and polymericmaterials, the formation of such structures is highly unusual in inorganic compounds. Most importantly, the mechanisms underlying self-rolling in solid inorganic phases are largely unknown. In the presence of polymer additives this effect is substantially more pronounced such that micro scrolls composed of a polymer/mineral hybrid material are obtained. This remarkable observation inspired us to systematically investigate film formation and curling behaviour in interface-grown basic cobalt carbonates depending on the concentration of the polymer additive as well as the composition und submicrometer structure of the resulting hybrid materials. Our results will facilitate a better understanding of the formation mechanisms leading to unusual inorganic micro scrolls. In particular, we discuss the role of intercalation of polymer molecules and ionic species into the interlayers of the film and their effect on materials properties.

**References**

1. Schenk A.S., Eiben S., Goll M., Reith L., Kulak A.N., Meldrum F.C., Wege C., Jeske H., Ludwigs S. (2017). Virus-directed formation of electrocatalytically active nanoparticle-based Co3O4 tubes. Nanoscale, 9, 6334.

Viktoria.gruen@uni-bayreuth.de