Nanocrystal growth of weak acid derivatives driven by acid-base neutralization

Baral PR[1] and Magrez A[1]*
*lead presenter: arnaud.magrez@epfl.ch
1 Crystal Growth Facility, Institute of Physics, Ecole Polytechnique Fédérale de Lausanne – EPFL, Switzerland

Arsenates, Boranes, carbonates, molybdates, perchlorates, phosphates, phosphites, selenates, selenites are derived from arsenic, boric, carbonic, molybdic, perchloric, phosphoric, selenic, selenious acid respectively. These materials derived from weak acids are found in every device and are the subject of intensive research for their exciting fundamental properties.
The growth of single crystals of nanometer size is an opportunity to explore and study enhanced properties or properties emerging from geometrical confinement. In this paper, we present on the solution growth of nanosized single crystals of weak acid derivative materials. The process relies on the ability of weak acid derivatives to partially or completely leach weak acids when exposed to a basic medium. As in a standard titration, the amount of leached acid will depend on the amount of base available so the stoichiometry and composition of the nanocrystal samples can be controlled with great precision.
First, we will use the example of Cu_2OSeO_3 grown from $CuSeO_3.2H_2O$ exposed to different bases to illustrate the advantages of the chemical process. The strength as well as the composition of the base influences the chemical mechanism, kinetics and thermodynamics of the growth process. Cu_2OSeO_3 is a well-established skyrmion host [1-3]. Grams of Cu_2OSeO_3 nanocrystals could be grown by leaching selenious acid from $CuSeO_3.2H_2O$. Refinement of the crystal structure from electron diffraction data confirms the structure of Cu_2OSeO_3 nanocrystals is identical to that of bulk single crystals [4]. Crystal size is tailored such as the geometrical confinement effect on the magnetic phase diagram of Cu_2OSeO_3 could be studied [5]. When confined in crystals smaller than 400nm, various topological spin textures like merons, and bobbers can stabilize in addition to skyrmions. When crystal size is below 190nm, no spin textures are observed [6].
Finally, it will be shown that the chemical process can be extended to other weak acid derivatives.

References (if needed)

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