Title	Crystallisation of inorganic nanostructures under confinement
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Project description:

The reason why in many application fields **crystallisation** is sought after is not straightforward. Nowadays, instead of focusing only on structure-properties relationships, **functionality-oriented crystallisation** is pursued. As already outlined in a previous work by some of us,[1] crystallinity is in many case *conditio sine qua non* for the **achievement of particular functional properties** among which, *inter alia*, luminescence as well as catalytic, electronic, and magnetic properties. Crystallisation pathways in inorganic nanostructure can affect the final properties of the resulting materials since the evolution of the first seeds to the nuclei and eventually their growth may dictate also the occurrence of anisotropy and of not-spherical morphologies. Crystallisation can be dramatically altered by **nanometric confinement**, for instance pursued by nanosized pores or droplets. The topic of this PhD project will be to investigate the **nucleation/growth phenomena occurring in the confined volume of miniemulsion droplets**, where unusual behavior of solvent molecules, limited precursor concentrations, Laplace pressure and further experimental conditions can affect the crystal growth. In particular, the **objectives** of the PhD project will be to investigate the crystallisation pathways in the confined space of the droplets and to identify the most relevant experimental parameters ruling the structural evolution towards crystals. Skills that will be acquired by the PhD student encompass both the field of synthesis (miniemulsion process) as well as the *ex-situ* (XPS, XRD, TEM, SEM), *in situ* and time-resolved characterization, by synchtrotron-assisted methods (XRD, XAS, SAXS), of the inorganic nanostructures. Modeling activity is also envisioned.

Publications:

1. S. Gross*, A. Vittadini and N. Dengo, *Functionalisation of Colloidal Transition Metal Sulphides Nanocrystals: A Fascinating and Challenging Playground for the Chemist*, Crystals, **2017**, *7*, 110
2. A. Antonello, P. Dolcet, K. Landfester, R. Muñoz-Espí and S. Gross* et al, *Synergy of Miniemulsion and Solvothermal Conditions for the Low Temperature Crystallization of Magnetic Nanostructured Transition Metal Ferrites*, Chem. Mater., **2017**, *29*, 985–997
3. S. Diodati, P. Dolcet, M. Casarin and S. Gross*, *Pursuing the Crystallization of Mono- and Polymetallic Nanosized Crystalline Inorganic Compounds by Low-Temperature Wet-Chemistry and Colloidal Routes*, Chem. Rev., **2015**, *115*, 11449–11502

Collaborations/Network:

- Prof. B. Smarsly, Physikalisch-Chemisches Institut, Justus Liebig Universität Gießen, Germany
- Prof. K. Landfester, Max Planck Institut für Polymerforschung, Mainz, Germany
- Dr. R. Muñoz-Espí, University of Valencia, Valencia, Spain

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[1] R. Muñoz-Espí, Y. Mastai, S. Gross and K. Landfester, Colloidal systems for crystallization processes from liquid phase (Invited), CrystEngComm, 2013, 15, 2175