


Internship proposal 2009-2010

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Mineral precipitation in microfluidic emulsion

Scientific project :

Hard tissues like bones, teeth, or mollusc shells are nanostructured materials resulting from processes of controlled biological mineralization.¹ This control, of cellular origin, starts with the formation of closed compartments, which will play the role of precipitation micro-reactors, wherein an active tuning of the ionic species concentrations will be set.

We wish to mimic the influence of these compartments by considering a water-in-oil emulsion formed using microfluidics. The use of a microfluidic device will allow to finely control the size of the generated droplets.² The influence of the confinement on the precipitated mineral phase, already observed on another model system³, will be investigated by varying the droplet diameter. Two systems will possibly be used, one based on an emulsification process induced by viscous shear, the other based on the emulsification by capillary destabilization.⁴ These two approaches are both fully mastered at the LIONS laboratory.

The salt mixing (sodium carbonate and calcium chloride for calcium carbonate precipitation) will be done using a 'herringbone' mixer included on the microfluidic chip. This mixer will be located upstream of the droplet formation. It will ensure a fast - of about a few seconds - and reproducible mixing. The set-up will be built using classical microfabrication techniques (optical lithography, PDMS polymer, etc.). The mineral characterization will be performed combining optical microscopy, infrared spectroscopy, X-ray diffraction and electronic microscopy.

¹ 2006, C. Chevallard & P. Guenoun, Bulletin de la SFP, **155** : 5-10, *Matériaux Biomimétiques*

² 2003, S. L. Anna et al., Appl.Phys. Lett. **82** : 364 -366, *Formation of dispersions using "flow focusing" in microchannels*

³ 2004, E. Loste et al, Adv. Funct. Mater. **14**: 1211-1220, *Preparation of CaCO₃ in confinement*

⁴ 2000, S. Sugiura et al., J. Colloid Interface Sci. **270** : 221-228, *Preparation characteristics of water-in-oil-in-water multiple emulsions*

Techniques in use :

Microfabrication techniques (optical lithography, PDMS polymer, etc.). The mineral characterization will be performed combining optical microscopy, infrared spectroscopy, X-ray diffraction and electronic microscopy.

Applicant skills :

Experimental skills are required for this study.

Granted internship : yes (700€/month) / no

C'nano IdF laboratory (France only) : yes

Possibility for a thesis : yes (type of grant : CFR) / no