

Labex MATISSE

« Toward a microfluidic model to understand pathological renal microcalcifications »

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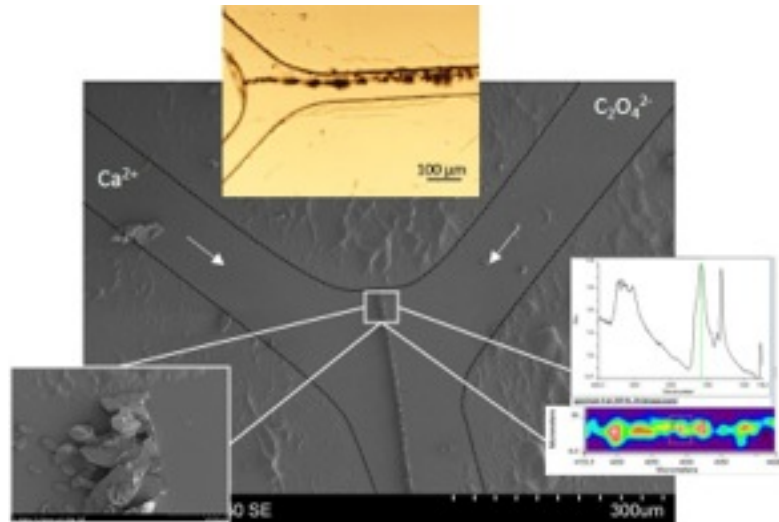


Figure: “Y-shaped” microfluidic device devoted to the synthesis and the characterization of calcium oxalate microcalcifications.

Hosting laboratories, teams and and thesis supervisors names:

1. Laboratoire de Chimie de la Matière Condensée de Paris (LCMCP), équipe SMILES, D. Bazin.
2. Laboratoire Physico-chimie des Electrolytes et Nanosystèmes Interfaciaux (PHENIX), équipe colloïdes inorganiques, A. Abou-Hassan.

Research project

Recent epidemiological studies have suggested an increased frequency of kidney stone disease in all age groups during the last decades affecting about up to 5% of the industrialized population. Microfluidic technology offers valuable potentialities to understand more deeply the pathogenesis of calcium oxalate crystals precipitation. Inside a microchannel, the conditions of mixing are representative of the biological fluids flows and exchanges inside the nephron microtubules (laminar flux).

In partnership with nephrologists from Tenon’s hospital, we have developed a microfluidic device dedicated to the synthesis of CaOx crystals. On a biochemical point of view, role of biological fluids, growth inhibitors (citrate ions), thermal effect and pH have been investigated. We will also investigate the influence of calcium-phosphate spherules present on organic matrix (collagen I) as an initiator site for calcium-oxalate crystals growth in order to mimic ectopic microcalcifications (Randall’s Plaques).

Scientific results & impacts

Based on the two-laminar flow technic, we used an elastomeric based microfluidic technology devoted to the precipitation of calcium-oxalate crystals. The device is composed of a “Y-shaped” microchannel in which both calcium and oxalate ions are injected. We demonstrate the potentialities of the method by studying the morphology (FE-SEM) and the chemistry (μ ATR-FTIR, μ DRX) of the crystallites obtained on the microchannel surface in different concentration ratio conditions (case of hypercalciuria).

Main key facts (for instance publications / prizes / oral presentations)

Publications :

- Chem Comm. In preparation
- Janus particles and urolithiasis: What can we learn from a Nature which dysfunctions ?
D. Bazin, D. Portehault, F. Tielens, J. Livage, Ch. Bonhomme, L. Bonhomme, F. Babonneau, J.-Ph. Haymann, A. Abou-Hassan, G. Laffite, V. Frochot, E. Letavernier, M. Daudon, CR Chimie Accepted