

Final Report

MaSNEC
Material Synthesis in Non-Equilibrium Conditions

Project number: 4248
M-ERA.NET Call 2016

Period covered: 1/10/2017 to 31/9/2021

Publishable project summary

Research performed during the MaSNEC project's has focused on growing innovative surfaces and control their properties via material synthesis in non-equilibrium conditions. The innovation has been to obtain solid material by precipitation reactions performed within diffusive gradients of concentration and convective flows due to injection of one reactant into the other. Such fluxes provide additional thermodynamic forces that are inaccessible in classical material synthesis in batch reactors in which the reactants are thoroughly mixed to maximize the rate of reaction. We have studied and characterize experimental protocols taking advantage of imposed out-of-equilibrium constraints to synthesize thermodynamically unstable solid polymorphs, manufacture nanoparticles and structured surfaces, composite coatings and multilayered tubes. We have also shown that the presence of injection and buoyancy-driven convection can impact the amount and the macroscopic spatial distribution of the solid phases produced.

By defining innovative procedures to structure and create new solid materials, this project has proposed a paradigmatic shift in the production of innovative materials with targeted relationships between their micro and macrostructures. The novel concept will impact material sciences and provide new routes to synthesize materials for societal and environmental applications.