

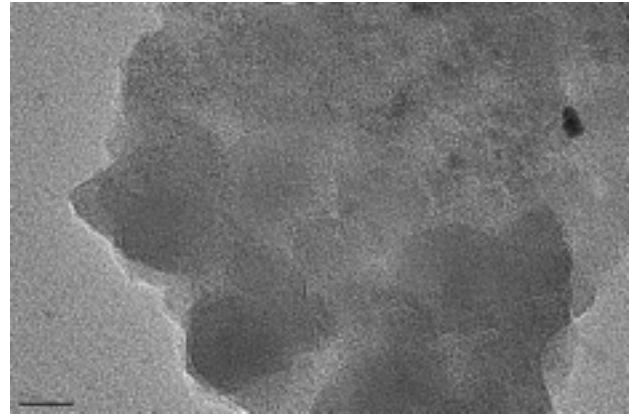
Labex MATISSE

Axe 5 Materials in extreme conditions

« Boron-based nanocomposites under extreme conditions »

Grosjean Rémi

LCMCP and IMPMC



Hosting laboratories, teams and thesis supervisors names:

- LCMCP, team MHN. Supervisors: Corinne Chanéac and David Portehault
- IMPMC, team DEMARE. Supervisors: Oleksandr Kurakevych and Yann Le Godec

Research project (10 lines)

The project *Boron-based nanocomposites under extreme conditions* sits at the crossroads between nanomaterials chemistry and the physics of solids at high pressure and high temperature (HPHT). The objective of its multidisciplinary approach is to synthesize nanostructured composite materials based on the crystalline phases of boron and containing nanoparticles as inclusions. Indeed, boron and boride materials exhibit unique properties, such as very high hardness, superconducting or refractory behaviors, among others. Nanostructuring of these phases, never achieved before, could drastically modify their properties. The project relies on the complementary skills of the two hosting laboratories: the development of the first chemical pathway towards metal-boron alloys nanoparticles at the LCMCP and their transformation under extreme pressure and temperature conditions at the IMPMC. The particles thus act as precursors of new nanostructured crystalline phases that can only be reached under extreme conditions.

Summarize your scientific results & impacts (5 lines)

The main results of the first 2 years are: (1) crystallization of β -B, at 5 GPa and 2000 °C, with 50 nm CaB_6 nanoparticles as inclusions. The reaction mechanisms and hardness properties of this new nanocomposite are being investigated; (2) crystallization of high pressure Ca and Hf borates from HfB_2 and CaB_6 nanoparticles, showing long range atom diffusion in boron matrices; (3) first nanostructuring of the ultrahard γ -B phase, obtained at 5 GPa vs. 10 GPa needed for the bulk phase. Studies of transformation mechanisms and large volume syntheses are

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

Communications:

- International symposium on boron, borides & related compounds, Honolulu, 2014, oral communication
- 9ème forum des Hautes Pressions, La Rochelle, 2014, oral communication
- Summer School C’Nano IdF, Etiolles, 2014, poster communication

Articles in peer reviewed journals:

- R. Grosjean, O. O. Kurakevych, C. Chanéac, Y. Le Godec, D. Portehault, New nanostructured precursors