17th Edition of International Conference on

Emerging Trends in Materials Science and Nanotechnology

April 26-27, 2018
Rome, Italy

Yann Le Godec, Nano Res Appl, Volume:4
DOI: 10.21767/2471-9838-C1-008

# HIGH PRESSURE SYNTHESIS OF NEW SUPERHARD NANOSTRUCTURED BORON COMPOUNDS

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**Superhard materials are widely employed in industry for production of cutting and polishing tools, as well as anti-abrasive coatings. The synthesis of man-made superhard phases started from the early 1950s, as soon as the development of high-pressure techniques allowed reaching the pressures necessary for diamond synthesis. However, the experimental and theoretical design of novel superhard materials still remains a great challenge to materials scientists. To this aim, experimental observations and simulations suggest that for many polycrystalline materials there is an optimal grain size (usually in the range of dozens of nanometers) which results in a significant, up to 50-70%, increase of hardness of the material in comparison with that of its coarse grain counterpart. This increase in hardness is known as the Hall–Petch effect. That's why the synthesis of bulk nanostructured materials remains the least-explored but challenging domain that allows combination of desired physical, chemical, and mechanical properties and gives rise to nanoelectronics, nanomechanics, band gap engineering, etc. Boron-based materials comprise many covalent diamond-like and boron-rich compounds whose structures are three-dimensional nets of short and strong covalent bonds responsible for their extreme hardness. In this talk, I will show that the use of very high pressures and temperatures combined with the *in situ* probe by x-ray diffraction with synchrotron radiation is the methodological key to control the composition and microstructure of new bulk nanostructured and superhard boron compounds and I will give many examples from our recent studies, leading to patent some new strategic compounds.**

**Recent Publications**

1. **J P Itié, E Girard, N Guignot, Y Le Godec and M Mezouar (2015) Crystallography under high pressure using synchrotron radiation, Journal of Physics D: Applied Physics 48, 504007.**

## Biography

Yann Le Godec is a CNRS Researcher and experienced user of large-scale instruments (ESRF, SOLEIL, DESY, DIAMOND, ILL, ISIS, etc.) for high pressure research. During last years, he has used high pressure to create new solids with advanced mechanical and physical properties. His activities led him to patent numerous new dense materials with light elements that have aroused considerable interest in search for novel superhard phases all over the world. He has been also leading in the development of *in situ* high pressure - high temperature diffraction techniques, both for x-rays and neutron studies. For his work, he has received the CNRS "Medaille de Bronze" Award.

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