

## Nanocomposites formed by boron nitride sheets and Fe nanoparticles for biomedical applications: Synthesis and characterization

T. H. Ferreira\*, G. F. Andrade and E. M. B. Sousa

Serviço de Nanotecnologia, Centro de Desenvolvimento da Tecnologia Nuclear, 30123-901, Belo Horizonte, MG, Brazil, email: tiago.hilario@hotmail.com

\* Corresponding author.

**Abstract** – This paper reports a facile synthesis of boron nitride nanosheets produced from elemental boron powder and ammonia gas in tubular furnace. Characterization of the materials was carried out by using X-ray diffraction, N<sub>2</sub> adsorption desorption isotherms, Fourier transformed infrared spectroscopy, and scanning electron microscopy. Such a material with these nanostructural characteristics seems to be promising for hosting and further delivery, under appropriate conditions, of a variety of molecules of pharmaceutical interest.

The hexagonal structure of boron nitride (h-BN) is geometrically similar to that of graphite in carbon structures. Hexagonal boron nitride sheets are known for their unique and important properties ideal for structural and electronic applications [1]. Recently some applications in the field of biomedical technology have been proposed because of its high chemical stability and the oxidation resistivity; these properties suggest a good biological inertia [2]. Considering such characteristics we could think that boron nitride sheets are suitable for the development of novel nanovectors for cell therapy, drug delivery, sensors and transducers for the detection of biomolecules, and other biomedical and clinical applications.

This paper reports a facile synthesis of boron nitride nanosheets produced from elemental boron powder and hematite (Fe<sub>2</sub>O<sub>3</sub>) in a weight ratio of 1:15. The sample was heated at 1300°C in an argon gas flow, and a flowing ammonia gas was introduced at this temperature for 2 h. After annealing, a gray sponge-like layer formed, and some colorless wool-like products were also observed. The obtained nanocomposite can be purified using hydrochloric acid to remove iron particles and some other impurities. Characterization of the materials was carried out by using X-ray diffraction, N<sub>2</sub> adsorption desorption isotherms, Fourier transformed infrared spectroscopy, and scanning electron microscopy.

The XRD pattern shows the diffraction peaks indexed to Fe and hexagonal BN phase. The FTIR spectrum is dominated by two peaks at around 790 and 1380 cm<sup>-1</sup>, which represent a shearing B–N–B binding mode and a stretching mode of the B–N binding modes, which are characteristic of hexagonal BN phase. The SEM images show layered structure in form of sheets with nanometric size. The N<sub>2</sub> adsorption results exhibit a typical adsorption isotherm with H3 hysteresis, according to the IUPAC classification, associated with the presence of slitlike porous and pore size ranging from 3.6 to 5.4 nm.

The synthesized h-BN presented a typical nanostructure described as boron nitride nanosheets. Such a material with these nanostructural characteristics seems to be promising for hosting and further delivery, under appropriate conditions, of a variety of molecules of pharmaceutical interest.

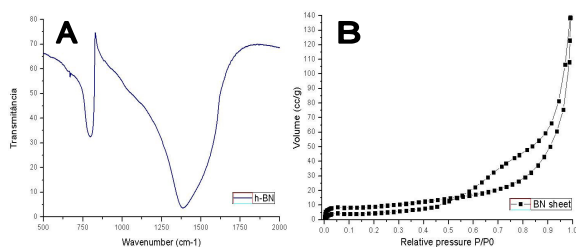


Figure 1: FTIR spectrum (A), and adsorption isotherm (B) of h-BN samples.

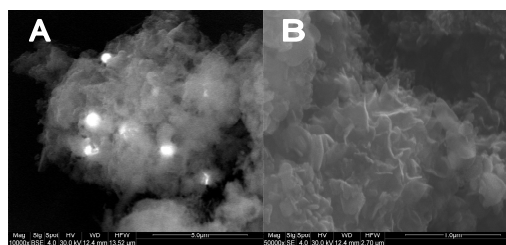


Figure 2: SEM images of h-BN with clear points of iron phase (A), and structure after purification (B).

### References

- [1] Liu L, Feng Y P and Shen Z X 2003 Structural and electronic properties of h-BN Phys. Rev. B 68 104102
- [2] G. Ciofania, V. Raffaa, A. Menciassia, A. Cuschieria; Nanotoday, Volume 4, Issue 1, February 2009, Pages 8-10

**Acknowledgment:** Work supported by the Brazilian agencies CNPq and FAPEMIG.