TUNABLE HYDROTHERMAL SYNTHESIS OF $BAMNO_3$ NANOCRYSTALS

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Although synthesis of nanooxides has been attempted by many different and innovative chemical approaches, further research is still needed to develop inexpensive and mass-production methods capable to provide pure products and thus make nanocrystals' technological applications viable.

Hydrothermal synthesis matches these requirements. Under hydrothermal conditions, where an aqueous reaction mixture is heated above 100 ºC in a sealed reaction container, density, ionic product, viscosity and dielectric constant of water change dramatically as a consequence of the autogenous pressure, creating a medium suitable for crystallization reactions that would not occur under conventional conditions[1]. As a relevant factor, the hydrothermal synthesis of multinary oxides is specially accessible in comparison with other approaches, due to the high solubility and mobility of species under these conditions.

Manganese oxides perovskites ($A_{1-x}A'_xMn_{1-y}M_yO_{3-\delta}$) or manganites exhibit a rich variety of structures (from one-dimensional to three-dimensional)[2] and outstanding properties, such as colossal magnetoresistance (CMR)[3-4], high permittivity[5], multifferroic behaviour[6-7], etc…As it is well-known, nanocrystals' properties strongly depend on their shape and dimensions. Nanomanganites have been prepared by hydrothermal route[8-12], but no precise control over the size and shape has been achieved. As a result, further research on hydrothermal reaction conditions is still required.

Herein, we report on the hydrothermal synthesis of single-cristalline nanoparticles of $BaMnO_3$. The particle size distribution of the resulting nanoparticles is found to be centered at 20-40 nm. Such a good control of the particle size and distribution is obtained by fine tune of reaction medium alkalinity and concentrations of the precursor metallic salts. We also evaluate the relevance of temperature, time and pressure on the final structural properties of the resulting products. The nanocrystals are thoroughly characterized by means of power X-ray diffraction (XRD), dynamic light scattering (DLS), transmission electron microscopy (TEM), high resolution transmission electron microscopy (HRTEM), electron diffraction (ED) and energy-dispersive X-ray analysis (EDAX). The magnetic behavior of the nanoparticles is finally discussed.

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Figures:

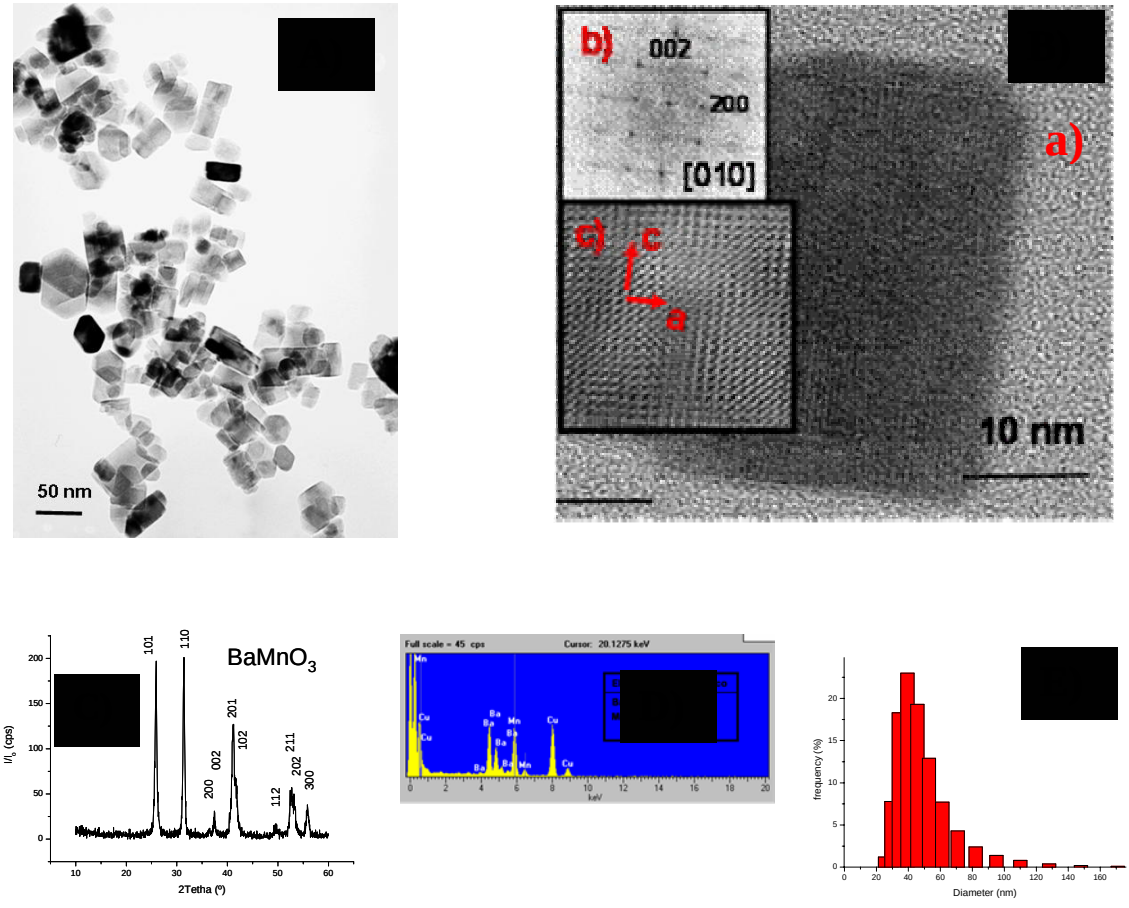

Figure 1. $BaMnO_3$ nanoparticles synthesized by hydrothermal method in alkali medium: A) TEM image; B) a) HRTEM image, b) Fourier transformed, c) filtered HRTEM image; C) DRX pattern; D) EDAX analysis; E) DLS size distribution.