Investigation of nanocrystalline tungsten- and tellurium-based triple perovskites

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Introduction
Specific structure of perovskite compounds provides them various interesting properties which vary from magnetic and electric properties to magnetic frustration and half-metallicity. Because of their properties they can be found in numerous technological applications such as transducers, memory devices, solar cells, etc. A3B5/2(W/Te)9O15 (A=Sr, Ba; B=Fe, Co) triple perovskites have been prepared in nanocrystalline form using a modified sol–gel route with citric acid as a chelating agent. These materials have been studied by X-ray powder diffraction (PXRD), transmission electron microscopy (TEM), selected area electron diffraction (SAED) and thermogravimetric analysis (TGA), while their magnetic properties have been determined using SQUID measurements. In this research the advances of solution chemistry methods (bottom up approach), namely sol-gel citrate route, over the solid state routes towards the synthesis of complex perovskite structures are presented.

Materials and Methods

Results

PXRD

Figure 1. X-ray diffraction patterns of synthesized phase pure compounds Sr2Co2WO9 (A), SrFe2TeO9 (B) and BaFe2TeO9 (C).

TGA

Figure 2. First derivative of TGA curve versus temperature of Sr2Co2WO9 (B), SrFe2TeO9 (C) and BaFe2TeO9 (A) after calcination at 600 °C showing the beginning of formation of desired compounds at 750 °C for Sr2Co2WO9 (A), 750 °C for SrFe2TeO9 (B) and 800 °C for BaFe2TeO9 (C) which is nearly in accordance with in situ X-ray diffraction measurements shown in Figure 3. A–C.

HRTEM/SAED

Figure 3. In situ X-ray diffraction patterns of synthesized compounds Sr2Co2WO9 (A), SrFe2TeO9 (B) and BaFe2TeO9 (C) after calcination at 600 °C showing the beginning of formation of desired compounds at 700 °C for Sr2Co2WO9 (A), 750 °C for SrFe2TeO9 (B) and 800 °C for BaFe2TeO9 (C) but still with some residual reflections of impurities compared to Figure 1A–C.

Conclusions
The formation of phase pure Sr2Co2WO9, SrFe2TeO9 and BaFe2TeO9 has been studied and magnetic properties of SrFe2TeO9 and BaFe2TeO9 have been determined. For BaFe2TeO9 shift of the maximum of AC susceptibility with frequency seems very small. Parameter J falls in a range typical for spin glasses rather than superparamagnets. It can be due to appreciate inter-particles interactions.

For SrFe2TeO9 there is no shift of AC susceptibility maximum with the frequency, probably because of the large interactions between nanoparticles. Ferromagnetic contribution is observed for both compounds, even at 370 K.