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ABSTRACTS

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ABSTRACTS

ORAL PRESENTATIONS

SYMPOSIUM A

Powder sintering of single-phase tetrahedrite materials

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There is a worldwide consensus for the development and implementation of zero global-warming-potential and energy efficient technologies. This energy transition requires more progress in all aspects related with renewable technologies, including the research and innovation on new and improved materials, e.g., materials for converting thermal wasted energy into electricity. This has attracted an increasing interest in the research of solid-state devices based on thermoelectric materials, which are capable of directly converting a heat flow into an electrical current flow, and vice versa, without hazardous emissions. However, for large-scale applications it is essential to have thermoelectric materials that are light, environmentally friendly, earth-abundant, cheap and with good thermoelectric properties. Tetrahedrite materials (based on $Cu_{12-x}M_xSb_4S_{13}$, where M is a transition metal like Zn, Fe, Mn, Ni, Co) are one of such class of materials. They are p-type semiconductors with large Seebeck coefficient and a complex crystal structure that is beneficial for thermoelectrical applications, as it leads to an extremely low thermal conductivity. Large power factors have been obtained by adjusting the content of the doping element resulting in zTs in the range of 0.7-1.1 at ~700 K. The most common preparation methods of tetrahedrite materials is a multi-step process mainly based on direct melting the pure elements in vacuum and involving annealing treatments and compaction techniques (like hot pressing or spark plasma sintering). However, the whole procedure employs high temperatures and can last up to several weeks.

In this study, we propose the direct synthesis of nanocrystalline and single-phase $Cu_{12-x-y}Fe_xZn_ySb_4S_{13-z}$ tetrahedrites, with $0 \leq x, y \leq 1$ and $0 \leq z \leq 0.3$, using an powder metallurgical route consisting in a short duration (2 h) high energy milling step followed by a subsequent densification step through hot pressing. Elemental powders of Cu, Fe, Zn and Sb and S pieces were used as starting materials. The influence of the chemical composition and of the doping elements will be presented in relation to the structural, thermal stability and thermoelectrical properties.

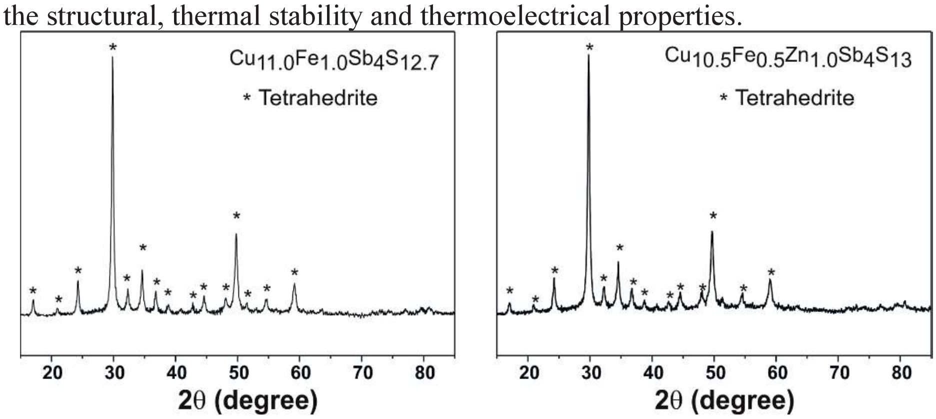

Figure 1 – X-ray diffraction patterns showing the formation of single-phase tetrahedrite after 2 h of high energy milling.

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