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## Natural Alternatives for Thermoelectric Materials

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Over the last decades, a growing concern regarding the origin and consumption of energy has taken place. Thus, an emerging search and effort for new and environmental-friendly alternatives has been acquiring strength. A promising solution are the thermoelectric materials and generators, which can harvest the waste heat and convert it into usable electricity, through the thermoelectric effects. Nevertheless, common thermoelectric materials include elements that are often rare, expensive and environmentally harmful. Tetrahedrites are naturally earth-abundant minerals of the sulfosalts group, with the ideal formula $Cu_{12}Sb_4S_{13}$, that have intrinsic low thermal conductivity (a desirable feature for thermoelectrics) and have revealed to possess a good thermoelectric efficiency at mild temperatures [1]. Additionally, tetrahedrites may be tailor-made to enhance their properties and suit better their final purpose. A common method to do it is doping, taking into consideration the general formula $Cu_{12-x}M_xSb_4S_{13}$, where M is a transition metal.

In this work, a study regarding the behaviour of doped synthetic tetrahedrites and combined natural samples prepared using ball-milling grinding method (380 rpm for 2 h), followed by hot-press sintering (575 ºC and 43.7 MPa for 1h30) was carried out. Throughout the study, different doping elements were used: Fe, Zn and simultaneously both, varying the amount between 0.5 and 1.5. Moreover, the amount of the natural based tetrahedrite mixed with synthetic samples varied between 20 and 80%.

Structural and microstructural studies of the resulting samples were performed using XRD and SEM, as well as the measurement of the Seebeck coefficient and electrical resistivity. Preliminary results show that the samples are dense and that the hot-press sintering is an appropriate method. Details on the thermoelectric properties will be given.

[1] X. Lu and D. T. Morelli, “Natural mineral tetrahedrite as a direct source of thermoelectric materials,” Phys. Chem. Chem. Phys., vol. 15, no. 16, pp. 5762–5766, (2013)