MS18-P09 | DETERMINATION OF HOST AND DOPANT ION DISTRIBUTION IN $Mg_2Si_{1-x}Sn_x$ THERMOELECTRIC MATERIALS BY ELECTRON CHANNELING

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Detailed structure studies by electron microscopy methods have been widely exploited due to the unique capabilities electrons provide. Precise identification of atomic positions is feasible by employing spectroscopy techniques in an analytical transmission electron microscope. In this aspect, methods such as energy dispersive X-ray spectroscopy (EDS) are utilised, under strong channelling conditions, where the yield of element characteristic X-ray emission can be modified and manipulated, dependent upon crystallographic directions of the incident beam. These channelling effects are powerful in determining atomic site locations in crystals and techniques such as ALCHMI (Atom Location by Channeling Enhanced MIcroanalysis) have been developed and evaluated.

Structural analyses employing electron channelling have a recent focus in systems for renewable technologies and energy harvesting, such as thermoelectric (TE) materials. TEs based on $Mg_2Si_{1-x}Sn_x$ have gained increased interest, due to inexpensive production costs, abundancy and a toxic nature of raw materials, especially for power generation applications within the intermediate temperature range (500–900 K). Synthesis of $Mg_2Si_{1-x}Sn_x$ in nanocrystal morphologies, often coupled by incorporation of dopants in their host matrix is exploited, with a scope to efficiently reduce thermal conductivity, particularly for Sn-rich or Bi doped Si-rich compounds. Previous studies confirmed the multiplicity of phases in this system, however, the precise distribution of host and dopant ions location is still controversial. Application of the electron channelling technique is therefore more than essential in order to accurately determine and refine their structural characteristics. Experimental outcomes will be demonstrated and discussed.