Micro and Nanostructure of Mg_2Si after Ageing

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Due to the rich reserves of the raw materials, along with their low cost and nontoxic nature, Mg_2Si-based compounds are well known as promising thermoelectric materials with moderate temperature operation. Despite the voluminous literature dealing with structural characterization as well as in-homogeneity studies of those materials, there is a lack of reports related to ageing studies, useful for the extensive use. Therefore, the present work provides characterization studies for the binary Mg_2Si doped with 2% Bi.

Long (20mm) bar-shaped samples were subjected to artificial ageing, by keeping its edges at elevated temperature for a prolonged time. Structural characterization was performed by using Electron Microscopy in both Scanning (SEM) coupled with EDS and Transmission (TEM) configurations. Room temperature IR measurements were performed with near normal light incidence in the range of 500-4000cm^{-1} using a Perkin Elmer i-series microscope, with 100μm iris. Scanning Seebeck and micro-FTIR measurements enable the mapping of dopant content in the samples after ageing.

The aim of this study is the investigation of the effect of thermal treatment on micro/nanostructure of magnesium silicide, as well as on dopant in-homogeneity. Elevated temperature at the edges of the sample cause crystallites that grow in size and thus, the concentration of larger crystallites (of the order of 1μm) was found higher at the edges, while nano-crystals (average size ~15nm) were more numerous at the center of the sample (Fig. 2, 3). The Seebeck coefficient (micro Seebeck scanning) was higher (in absolute values) at the edges of the sample (Fig. 1) in agreement with the lower local free carrier concentration in the same sample following from micro FTIR measurements.

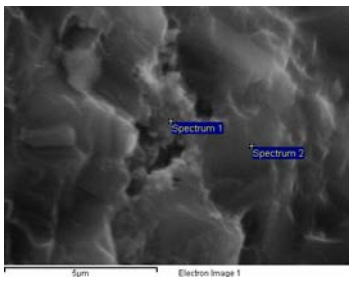

Figure 1 (SEM) Smaller crystallites are numerous at the center part of the sample. EDS reveal that smaller crystallites have higher Bi content.

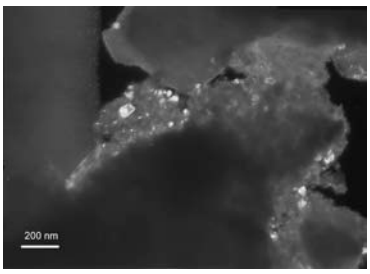

Figure 2 (TEM) Small crystallites (average size ~15nm) are more frequently observed, and are more numerous in the center part than at the edges

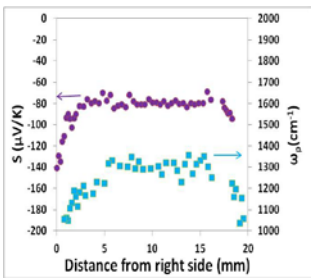

Figure 3 (Seebeck/FTIR) Seebeck coefficient (S) and plasmon frequency (ω_P) variation along the long axis of the sample, after aging.

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