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Improving power factor and mechanical properties of $Yb_{14}MgSb_{11}$ for application in a Radioisotope thermal generator

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Abstract.
Radioisotope thermal generators use thermoelectric materials to convert heat from plutonium-238 oxide into electricity. The efficiency of a thermoelectric material is defined by the thermoelectric figure of merit, $zT = (S^2T)/\rho\kappa$, where S = Seebeck coefficient, ρ = electrical resistivity, κ= thermal conductivity and T = absolute temperature and the output power density is defined by the power factor ($PF = S^2/\rho$). $Yb_{14}MgSb_{11}$ is one of the best high temperature *p*-type thermoelectric materials with a *zT* of 1.02 at 1075 K. Compositing thermoelectric materials with transition metal elements has been shown to improve *zT* and mechanical properties. A high *zT* leads to high efficiency in devices while improved mechanical properties lead to easier device fabrication and longer device lifetime. $Yb_{14}MgSb_{11}$ was composited with 1-8 vol% Fe by mechanical milling and reactive sintering to produce fully dense pellets. Fe was chosen as it is a p-type metal and it was not expected to react with $Yb_{14}MgSb_{11}$. Results show a 40% increase in thermoelectric power factor at 8 vol% Fe and an 11% increase in *zT* at 1-3 vol% Fe. The composites show a 2.1% increase in Vickers hardness values for the 4 vol% Fe samples. The synthesis and properties will be presented and discussed.

Keywords: Composite, Thermoelectric, Power factor improvement, Radioisotope thermal generators.