

A new direct p-n junction based on Heusler compounds manufactured by co-sintering

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Thermoelectric modules have potential for widespread applications, but their cost needs to be reduced to make them economically feasible. When using low-cost thermoelectric materials, the cost drivers are material processing and assembly (including ceramic substrates). Innovative processing techniques and thermoelectric module geometries are necessary to mitigate these costs. In addition, the stability of hot side contacts is a significant concern when dealing with medium/high-temperature ranges. The p-n junction geometry (see Figure 1) could be a solution to these two challenges, simplifying the whole process and avoiding the need for a hot side metal contact.

In this work, we propose a low-cost Heusler p-n junction thermoelectric module. Finite element modelling (FEM) was used to perform a sensitivity analysis and determine the optimal geometry. A three-material co-sintering process was used to manufacture p-n junctions with the cold-side electrodes in a single step. Finally, experimental characterization was performed on the p-n junctions. The results show that the p-n junction is competitive with the π -type geometry but at a much lower production cost.

In conclusion, this work presents a low-cost Heusler p-n junction thermoelectric module with hot-side direct contact. The proposed manufacturing process and geometry could be used to reduce the cost of thermoelectric modules, making them a viable option for various applications at high temperature.

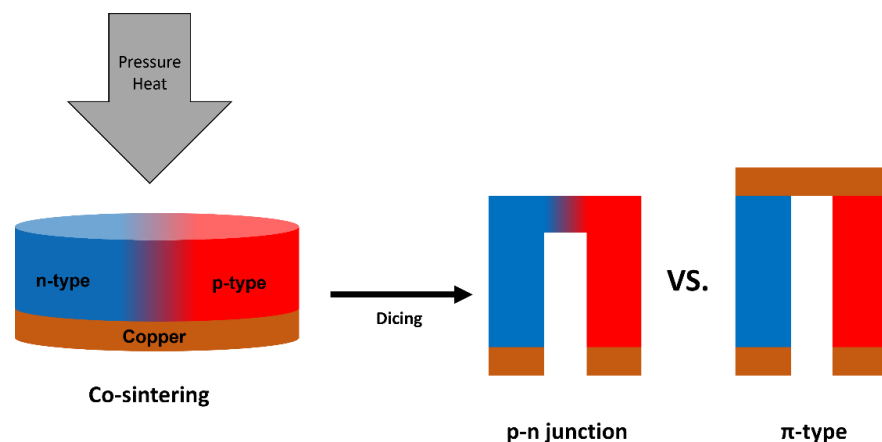


Figure 1. Sketch of the co-sintering process and the p-n junction geometry studied in this work.