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Interfacial Properties of Cu/Ni/Mg_2Si Joints Prepared in One Step by the Spark Plasma Sintering Method

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Abstract

Cu/Ni/Mg_2Si thermoelectric bonded joints were prepared in one step by the spark plasma sintering (SPS) method using Mg and Si powders to form Mg_2Si. The microstructure and elemental distribution across the interfaces were determined, and the formation of new phases at the interface was investigated and related to joint properties, including shear strength and contact resistance. Joint formation was accompanied by the formation of two ternary Mg-Si-Ni layers, an η-layer with Ni_2Si as a precipitate next to Ni, and an ω-layer next to Mg_2Si. The formation and characteristics of these layers played a major role in determining the shear strength and contact resistance. It was determined that a reactive sintering temperatures in the range 1023-1053K with a 15-20 min hold time provided the best properties. The maximum shear strength of the joints obtained is 26MPa for samples sintered at 1023K. For these samples the contact resistance was 1.44 mΩ•cm^2; the minimum value of 1.28mΩ•cm^2 was measured for samples sintered at 1073K. Long-term thermal stability of joints was also investigated.

Keywords: Thermoelectric Materials; SPS; Magnesium Silicide; Shear Strength; Contact Resistance