

Peculiarities of Thermoelectric half-Heusler Phase Formation in {Gd,Lu}-Ni-Sb Ternary Systems

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Semiconductor compounds which crystallize in MgAgAs structure type (so called half-Heusler phases) belong to the objects, which are very intensively investigated as the perspective materials for the direct conversion of the heat energy into electric current. The semiconducting properties of the half-Heusler intermetallic phases are in many cases very sensitive to the heat treatment, suggesting some structural disorder and the existence of the homogeneity domains. For the proper understanding of these influences, a detailed knowledge of the phase relations is necessary. The phase equilibria in the Gd-Ni-Sb and Lu-Ni-Sb ternary systems have been studied in the whole concentration range by means of X-ray and EPM analyses at 873 K. The interaction between the elements in Gd-Ni-Sb system results in formation of five ternary compounds at investigated temperature: GdNiSb (MgAgAs-type), Gd₅Ni₂Sb (Mo₅SiB₂-type), GdNi₂Sb₂ (CaBe₂Ge₂-type), GdNiSb₂ (HfCuSi₂-type) and Gd₅Ni_{0.965}Sb₂ (Yb₅Sb₃-type). The Lu-Ni-Sb ternary system is characterized by formation of three ternary intermetallics at 873 K: LuNiSb (MgAgAs-type), Lu₅Ni₂Sb (Mo₅SiB₂-type) and Lu₅Ni_{0.56}Sb_{2.44} (Yb₅Sb₃-type). Under used conditions according to EPM analysis the composition of the half-Heusler RNiSb compounds deviates from stoichiometry toward to lower Ni content indicating the disordering in their crystal structure. The electrical properties measurement performed in the temperature range 80-380 K showed that GdNiSb and LuNiSb compounds with MgAgAs structure type are heavily-doped semiconductors.