

Thermoelectric power of $\text{AgY}_{1-x}\text{Gd}_x(\text{WO}_4)_2$ tungstates

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Double molybdates and tungstates $\text{ARE}(\text{MO}_4)_2$ (A = monovalent metal, e.g. an alkali metal or Ag, and Tl, RE – trivalent rare-earth metal, and M = Mo or W) are good laser hosts, and have potential applications in quantum electronics, visual display, and solid-state lighting. Especially, the low-temperature modifications of $\text{KRE}(\text{WO}_4)_2$ (RE = Y, Gd, and Lu) doped with Nd^{3+} , Ho^{3+} , Er^{3+} , Tm^{3+} , and Yb^{3+} ions are commonly used inorganic materials for high-power and short-pulse diode-pumped solid-state lasers [1-3]. The advantages of these materials are their high physical and optical anisotropy resulting from low symmetry structure, a wide range of laser emission, and a possibility of high doping levels due to close ionic radii without luminescence quenching and significant lattice distortions. In this work, we have been successfully synthesized by a high-temperature solid-state reaction new $\text{AgY}_{1-x}\text{Gd}_x(\text{WO}_4)_2$ solid solutions for $x = 0.005-0.20$ using Ag_2WO_4 and $\text{RE}_2(\text{WO}_4)_3$ (RE = Y and Gd) as the starting materials. The synthesis of samples under study can be described by the following equation:



Low-temperature polymorphs of $\text{AgY}_{1-x}\text{Gd}_x(\text{WO}_4)_2$ solid solutions crystallize in monoclinic symmetry belonging to the $C2/m$ space group. These phases are thermally stable to the temperature of 1238 K, i.e. to the temperature of polymorphic change of pure $\text{AgGd}(\text{WO}_4)_2$.

The electrical resistivity $\rho(T)$ of $\text{AgY}_{1-x}\text{Gd}_x(\text{WO}_4)_2$ has been measured in the temperature range of 76-400 K with the aid of the four-probe DC method using a KEITHLEY 6517B Electrometer/High Resistance Meter. The thermoelectric power $S(T)$ was measured in the temperature range of 300-600 K with the aid of a Seebeck Effect Measurement System (MMR Technologies, Inc., USA). The $\rho(T)$ and $S(T)$ measurements showed the insulating properties and n -type conduction. At high temperatures, i.e. above 400 K, we find a rather well defined linear slope of $S(T) = aT$ (diffusion thermopower) which extrapolates to (0, 0) [4]. For the larger Gd^{3+} concentration, the larger value of the diffusion coefficient a is observed. When Gd^{3+} is low this effect is smaller and reversal of thermoelectric power sign is being observed. The residual electrical conduction of the type n or p in the tungstates under study seem to be connected with the anionic or cationic vacancies, respectively, the same as it was observed in the $\text{CdRE}_2\text{W}_2\text{O}_{10}$ compounds [5]. The changes of sign observed in $S(T)$ can be an effect of the different values of the activation energy of the vacancy acceptor and donor levels.

One of us (J.G.) thanks the National Science Center (NCN) for financial support, on the basis of Decision No. DEC-2012/07/B/ST3/03027.

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