Investigation of Magnetocaloric Effect in $RE_5Pd_2In_4$ (RE = Tb–Tm) Compounds

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Magnetocaloric measurements of the $RE_5Pd_2In_4$ (RE = Tb–Tm) rare earth compounds were examined with the use of the Vibrating Sample Magnetometer (VSM) option of the Physical Properties Measurement System by Quantum Design. The maximum magnetic entropy change ($-\Delta S_M^{max}$) at magnetic flux density change ($\Delta\mu_0 H$) 0–9 T was determined to be 3.3 $J{\cdot}kg^{-1}{\cdot}K^{-1}$ at 60 K for $Tb_5Pd_2In_4$, 7 $J{\cdot}kg^{-1}{\cdot}K^{-1}$ at 20 K for $Dy_5Pd_2In_4$, 12.6 $J{\cdot}kg^{-1}{\cdot}K^{-1}$ at 20 K for $Ho_5Pd_2In_4$, 12.1 $J{\cdot}kg^{-1}{\cdot}K^{-1}$ at 18 K for $Er_5Pd_2In_4$ and 11.9 $J{\cdot}kg^{-1}{\cdot}K^{-1}$ at 8 K for $Tm_5Pd_2In_4$. The temperature averaged entropy change (TEC) for each compound with a 5 K span was also calculated, leading to the values of 3.19, 6.96, 12.63, 12.16, and 11.84 $J{\cdot}kg^{-1}{\cdot}K^{-1}$ for RE = Tb–Tm, respectively. The relative cooling power (RCP) and refrigerant capacity (RC) equal respectively 258 and 215 $J{\cdot}kg^{-1}$ in $Tb_5Pd_2In_4$, 498 and 325 $J{\cdot}kg^{-1}$ in $Dy_5Pd_2In_4$, 489 and 403 $J{\cdot}kg^{-1}$ in $Ho_5Pd_2In_4$, 403 and 314 $J{\cdot}kg^{-1}$ in $Er_5Pd_2In_4$ and 234 and 184 $J{\cdot}kg^{-1}$ in $Tm_5Pd_2In_4$. The magnetocaloric performance of $RE_5Pd_2In_4$ is comparable to that of other low-temperature magnetocaloric materials, reaching the highest values in the case of RE = Ho and Er which show good magnetocaloric performance over a wide range of temperatures. Furthermore, $RE_5Pd_2In_4$ (RE = Tb–Tm) have the highest RCP and RC among other transition metal compounds $RE_5T_2In_4$ (T = Ni, Pt).

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