Magnetocaloric effect in thin films of the Laves phases TbCo$_2$ and DyCo$_2$ grown on SiO$_x$ substrate

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In the present study, we show the preparation process and magnetocaloric properties of polycrystalline thin films of intermetallic compounds TbCo$_2$ and DyCo$_2$. These compounds belong to the Laves phases [1], which are promising magnetocaloric materials in the low temperature range [2]. The samples were fabricated using the Pulsed Laser Deposition technique. The layers were deposited onto naturally oxidized silicon (100) and Al$_2$O$_3$ (11$\bar{2}$0) [3] substrates to investigate the influence of the substrate on the quality of the grown materials. The crystal structure of the prepared materials was verified by X-ray diffraction method. The studies indicated the presence of a texturized cubic MgCu$_2$-type phase (space group $Fd\bar{3}m$, No 227) for thin films deposited on both substrates. Measurements of magnetization as a function of temperature revealed anomalies for thin film samples around the Curie temperatures denoted for bulk materials at $T_\mathrm{C} = 230$ K for TbCo$_2$ and at $T_\mathrm{C} = 135$ K for DyCo$_2$ [4,5]. The determined magnetocaloric parameters, magnetic entropy change ΔS_M and relative cooling power RCP, for a change of magnetic field of 5 T, are equal to $-\Delta S_\mathrm{M} = 4.3$ J kg^{-1} K^{-1} and $RCP = 121$ J kg^{-1} at $T = 217$ K for TbCo$_2$, while $-\Delta S_\mathrm{M} = 4.4$ J kg^{-1} K^{-1} and $RCP = 23$ J kg^{-1} at $T = 127$ K for DyCo$_2$.

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