Magnetic and magnetocaloric properties of $EuCu_2Sb_{2-x}Sn_x$

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Europium-based intermetallic compounds exhibit a wide array of emergent phenomena, including heavy fermion behavior, quantum criticality, and superconductivity, largely driven by the stability of the Eu^{2+} magnetic moment and its response to external tuning. This work investigates the effect of chemical substitution on the physical properties of $EuCu_2Sb_2$, which crystallizes in the tetragonal $CaBe_2Ge_2$-type structure (space group $P4/nmm$, no. 129) and undergoes an antiferromagnetic transition at $T_N = 5.1$ K. We examine how the substitution of Sn for antimony Sb influences the structural and magnetic characteristics of the $EuCu_2Sb_{2-x}Sn_x$ system. Polycrystalline samples were synthesized via arc melting, and their phase purity was confirmed by X-ray diffraction. Magnetic measurements reveal that the Néel temperature increases systematically with Sn content. While the maximum isothermal magnetic entropy change ($|\Delta S_M|$) decreases from 6.59 J kg^{-1} K^{-1} for $x = 0$ to 3.21 J kg^{-1} K^{-1} for $EuCu_2Sn_2$, it remains above 5 J kg^{-1} K^{-1} for a broad concentration range. Notably, the addition of Sn significantly enhances the Relative Cooling Power (RCP), which increases from 36 to 74 J kg^{-1} (for $\Delta\mu_0 H = 5$ T at x = 0.2). These results demonstrate that Sn substitution broadens the operating temperature range of the magnetocaloric effect and improves the overall cooling efficiency of the system.

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