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Magnetocaloric effect in antiferromagnetic EuCu2Sb2 compound

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Europium-based intermetallic compounds and alloys represent a fascinating class of materials, particularly due to the presence of divalent Eu^{2+} ions, which can give rise to a variety of magnetic and thermodynamic phenomena. Among these, the magnetocaloric effect (MCE) has attracted considerable attention, especially for applications in magnetic refrigeration at cryogenic temperatures. Some Eu-bearing compounds are among the most efficient known magnetocaloric materials in the low-temperature regime, making them highly relevant for fundamental studies and potential technological applications. In this study, we focus on the magnetocaloric properties of the antiferromagnetic intermetallic compound $EuCu_2Sb_2$, which crystallizes in the tetragonal $CaBe_2Ge_2$-type structure (space group $P4/nmm$, no. 129). Structural characterization confirms the high quality of the polycrystalline sample, and magnetization measurements reveal an antiferromagnetic transition at 5.1(1) K. Electrical resistivity data indicate metallic-type electron transport, consistent with the behavior observed in similar Eu-based intermetallic systems. Magnetization isotherms were used to evaluate the magnetocaloric response of $EuCu_2Sb_2$. The compound exhibits both normal and inverse magnetocaloric effects, depending on temperature and field conditions. The maximum isothermal magnetic entropy change ($-\Delta S_{\mathrm{m}}$) for the normal MCE reaches 13.2(1) $\mathrm{Jkg^{-1}K^{-1}}$ near 6 K under an applied magnetic field change of 5 T. Additionally, the relative cooling power (RCP) is estimated to be 136(8) $\mathrm{Jkg^{-1}}$ for the same field variation. Our findings contribute to a deeper understanding of magnetocaloric behavior in Eu-based antiferromagnets and highlight $EuCu_2Sb_2$ as a potential candidate for cryogenic cooling technologies.

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