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Dipolar-Biased Tunneling of Magnetization in Crystals of Single Molecule Magnets

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The molecular cluster Mn12 has attracted much interest as a single-molecule magnet (SMM) and as a multi-redox system. It has a high-spin ground state of S=10 and a strong uniaxial magnetic anisotropy, and the combination of the two natures makes an effective potential barrier between the up and down spin states. At low temperatures, the magnetization curve exhibited a hysteresis loop and the quantum tunneling of magnetization (QTM). In the present work, we studied the structure and magnetic properties of the mixed-metal SMM, Mn11Cr, through the analysis of Mn11Cr/Mn12 mixed crystal. High-frequency EPR spectra were well explained by assuming that Mn11Cr was in a ground spin-state of S=19/2 with nearly the same EPR parameter set as for Mn12. QTM in Mn11Cr was observed with the same field interval as for Mn12. The magnetization of Mn11Cr and Mn12 in the mixed crystal can be independently manipulated by utilizing the difference between their coercive fields. The resonance fields of QTM in Mn11Cr are significantly affected by the magnetization direction of Mn12, suggesting the effect of dipolar-biased tunneling. Besides SMM, we would also like to report the unusual magnetic properties of spherical hollow nanomagnets, the electrical properties of heterocyclic thiazyl radicals, and their possible applications in spintronics and organic electronics.