Employing Lanthanides and Actinides in the Construction of Single-Molecule Magnets

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Single-molecule magnets can retain spin information over long periods of time at low temperature suggesting possible applications in high-density information storage, quantum computing, and spintronics. However, their implementation hinges on enhancing the energy barrier to spin inversion, and thus increasing the temperatures at which they can operate. The lanthanides and actinides are proving particularly well suited for this, since their large unquenched orbital moments and strong spin-orbit coupling can produce single-ion anisotropies unparalleled in the periodic table. Progress in raising the spin-inversion barrier by increasing the single-ion anisotropy and strengthening magnetic exchange coupling will be discussed – primarily in terms of the first actinide single-molecule magnets, (U(R₂BP₂Z₂)₃; R = Ph, H), and several N₂³⁻ radical-bridged lanthanide complexes, {([Me₃Si]₂N)₂(THF)Ln)₂(μ-η²:η²-N₂)}⁻ (Ln = Gd, Dy).