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Strong Exchange Anisotropy in Heavy Atom Radical Ferromagnets[1]

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The discovery twenty years ago of ferromagnetic ordering in "light atom" p-block (N, O based) radicals appeared to provide a major conceptual advance, suggesting the possibility of a new era in non-metal molecular magnetism. However, the weak through-space magnetic exchange interactions present in these early radical-based ferromagnets afforded very low Curie temperatures T_C (< 2 K), and the localization of spin density on light atoms ensured low coercive fields H_c (< 100 Oe). In this context, the observation of ferromagnetic ordering in "heavy atom" (Se) radicals, with T_C as high as 17 K and coercive fields H_c up to 1370 Oe (at 2 K), represents a significant improvement in properties. This presentation will provide a theoretical and experimental examination of the source of the large coercive fields reported for these "heavy atom" radical ferromagnets. High-field ferromagnetic resonance (FMR) measurements, interpreted in the context of the anisotropic exchange interactions between the radicals in the solid state, leads to the conclusion that spin-orbit effects are responsible for the large observed magnetic anisotropy. This conclusion is supported by detailed analysis of the symmetry and magnitude of the spin-orbit interactions. An interesting discussion is the extent to which these anisotropic exchange terms also contribute to the enhancement of T_C. That is, in the field of organic magnetism, where low dimensional magnetic structures are commonly found, long range ordering may depend crucially on such anisotropy.

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