Low, 2- or 3-Coordination Number Transition Metal Complexes and Their Magnetic Properties

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The main themes of the lecture will be the presentation of synthetic routes to low-coordinate complexes of the first row transition elements. In addition, their structures, spectroscopic properties, and chemistry will be discussed. Several of the complexes are characterized by very high orbital magnetic moments, high zero field splittings (ZFS), and potentially high barriers to spin reversal, and thus potential application as single molecule magnets (SMMs).

The lecture will be divided into two parts. The first will deal with divalent derivatives of iron, cobalt, and nickel with two-coordinate linear and non-linear geometries. Interest in such complexes is inspired by the notion that since the ligands are disposed along one axis only, the complexes should have high magnetic anisotropies and high ZPS. It will be shown that, for the linearly coordinated iron and cobalt complexes, free ion magnetism — that is to say, almost completely unquenched orbital magnetism — can be observed, together with single-molecule magnet (SMM) behavior. In contrast, when the geometry deviates from linearity, the orbital moment becomes quenched with considerable lowering of the magnetic moment. It will also be shown that dispersion forces play a prominent role in stabilizing linear coordination.

The second part of the lecture will focus on complexes of the earlier metals — in particular, chromium and vanadium, where the first examples of strictly linearly-coordinated metal complexes have been synthesized. Magnetic measurements show that their magnetic moments are lower than the spin-only values because of the different sign of the spin orbit coupling constant in the early metals. Attempts to synthesize the first example of a two-coordinate titanium(II) complex will also be described.

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