CMP Seminar
Michigan State University

The magnetism of double perovskites containing osmium: Developing rules to predict superexchange interactions between 5d and 3d ions

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The rules governing superexchange interactions between 3d and 4d/5d transition metal ions have long puzzled scientists. Over the past several years we have been synthesizing and studying the magnetic properties of A_2MOsO_6 and A_2MReO_6 (Mg, Zn, Cr, Fe, Co, Ni) double perovskites in a quest to understand how the sign and strength of the superexchange interactions change as a function of the relative filling of the 3d and 5d orbitals as well as the geometry of the crystal structure. Differences in the energy levels of the 3d orbitals and the Os/Re 5d orbitals causes the 3d−5d superexchange coupling through the e_g orbitals to be insignificant, thereby allowing the 5d−5d and 3d−3d superexchange coupling to be competitive. The strength of the competing superexchange interactions can be tuned by changing the filling of d-orbitals and are highly sensitive to changes in chemical pressure. Using these tools we can access magnetic states ranging from ferrimagnetic to antiferromagnetic to spin glasses. The findings of this work have important implications for efforts to design and understand magnetic materials for the 21st century.

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Prof. Xianglin Ke - Host