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The Chemical Control of Electronic Oxides - Order/Disorder of Cations, Charges and Spins

<Abstract:

Metal oxides that are magnetic, conducting or superconducting have important technological applications and also provide many challenges for materials chemistry and physics. Disorder is often present in these materials because chemical doping is required to induce the interesting properties, for example, substitution of strontium for lanthanum in the (La2-xSrx)CuO4 superconductors and the (La1-xSrx)MnO3 CMR (colossal magnetoresistance) perovskites. A simple approach to understand how disorder affects the properties is provided by considering the mean and variance in the size distribution of the (La,Sr) or other cation mixtures. Notable properties are often found in oxides that are 'self-doped' without the need to introduce additional cations. This is illustrated by RuSr2GdCu208, which is both magnetic and superconducting because of overlap of the Ru and Cu electronic bands, and by magnetite, Fe304, which is a ferromagnetic conductor and ambient temperatures, but becomes a charge ordered insulator below the 122 K Verwey transition.