Magnetoresistance Caused by Spin-polarized Variable Range Hopping–Perovskite Ruthenates

I-W. CHEN, F. HUANG, Department of Materials Science and Engineering, University of Pennsylvania, Philadelphia, PA19104-6272, USA — We report a detailed study of A-site and B-site substitution on magnetoresistance of perovskite ruthenates, which have broad implications. By progressively disrupting the conducting pathway in the ferromagnetic SrRuO$_3$, we found it first undergoes Anderson localization, then exhibits very large negative magnetoresistance (exceeding -60% compared to the zero-field resistance). The implication is that any ferromagnetic metal should acquire a large magnetoresistance when it is rendered insulating by way of disorder, regardless of whether the disorder is caused by a magnetic or nonmagnetic impurity. This pathway is especially feasible in strongly correlated metals such as SrRuO$_3$. A model based on variable range hopping of spin-polarized electrons can quantitatively explain the data.