Title: Crystallographic and electronic properties of rare-earth $A_2B_2O_7$ oxides under extreme conditions

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Abstract: This work presents a systemic study of rare-earth $A_2B_2O_7$ oxides, focussing on the B = Ir iridate series. The structural, electrical transport, and magnetic properties of most $A_2Ir_2O_7$ iridates were investigated under extreme conditions, namely down to low temperatures, up to high magnetic fields, and under high external pressure. Both polycrystalline and single-crystalline samples were synthesised and characterised. Presented synchrotron study of the compressibility of the pyrochlore structure, stable at temperatures down to 4 K, at pressures of up to 20 GPa and with A substitution, pave the way for understanding the electronic and magnetic properties of $A_2Ir_2O_7$ iridates. The magnetic phase transition and concomitant semiconductor-insulator transition were followed in the heavy-rare-earth part of the series. Importantly, the nature of the semiconductor-insulator transition is ascribed to the Slater-type mechanism (opening of the insulating gap due to the antiferromagnetic ordering of magnetic moments) without Brillouin-zone folding, based on the electrical resistivity and magnetisation data. Applied external pressure enhances both the insulating and antiferromagnetic phases, as demonstrated for the $Lu_2Ir_2O_7$ end-member. Magnetic properties of these materials are shown to be strongly dependent on the antiferromagnetic domain structure, especially on the small ferromagnetic component pinned at the domains' interfaces. Theoretical calculations predicting the dimensions of the domains were performed.

Keywords: $A_2B_2O_7$ oxides, pyrochlore structure, metal-insulator transition, domain walls