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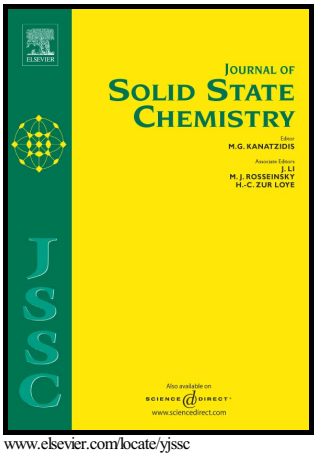

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Structural and Magnetic Studies of the Ruthenium Perovskites $Ba_{2-x}Sr_xHoRuO_6$

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Abstract:

The series of ruthenate double perovskites $Ba_{2-x}Sr_xHoRuO_6$ ($0 \leq x \leq 2$) have been synthesized using solid state methods. The crystal structures of the series have been determined by high resolution synchrotron X-ray diffraction and show the sequence of structures to be $Fm\bar{3}m$ ($a^0a^0a^0$) ($0 \leq x \leq 0.6$) → *I4/m* ($a^0a^0c^-$) ($x = 0.8$) → *I2/m* ($a^0b^-b^-$) ($1.0 \leq x \leq 1.2$) → *P2₁/n* ($a^-a^-c^+$) ($1.4 \leq x \leq 2.0$). A similar progression of structures is observed in the sample $BaSrHoRuO_6$ with increasing temperature. Magnetic characterisation of these materials was undertaken utilising variable temperature bulk magnetic susceptibility, isothermal magnetisation and low temperature neutron powder diffraction measurements. All members of the series order antiferromagnetically with the Ru and Ho sublattices ordering at different temperatures between 50 and 16 K. The presence of the magnetic Ho^{3+} at the perovskite *B* site stabilises the antiferromagnetic (AFM) ordering of the Ru sublattice. The addition of Sr for Ba beyond $x = 1.2$ weakens the AFM superexchange interactions through induced structural distortions, resulting in a canted AFM ground state.

Graphical abstract

The structure and magnetic properties of the series of ruthenate double perovskites $Ba_{2-x}Sr_xHoRuO_6$ ($0 \leq x \leq 2$) are described. Replacing the Ba cation with the smaller Sr cation lowers the symmetry from cubic to monoclinic which weakens the antiferromagnetic superexchange, resulting in a canted AFM ground state for Sr_2HoRuO_6.