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Investigating the Potential Verwey Transition in Pb3Rh7O15 with Synchrotron X-rays

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The Verwey transition is a phase transition in which the development of charge order results in a rapid increase in electrical resistivity. This transition was first observed in magnetite (Fe3O4), which undergoes a metal-insulator transition at T ˜ 125 K, driven by the formation of complex Fe2+/Fe3+ order. Recently, it was proposed that a similar type of transition may occur in Pb3Rh7O15, a mixed valence (Rh3+/Rh4+) rhodate which displays an abrupt increase in resistivity at T ˜ 185 K, accompanied by corresponding anomalies in specific heat, magnetic susceptibility, and diffraction data. If true, this material would mark the first example of Verwey-type physics in a heavy 4d or 5d transition metal oxide system. We have carried out a series of synchrotron x-ray scattering measurements on single crystal samples of Pb3Rh7O15 with the goal of (a) clarifying the high and low temperature crystal structure of this compound, and (b) identifying any evidence of Rh3+/Rh4+ charge ordering below T ˜ 185 K.

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