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Absence of ferroelectricity in hexagonal $InMnO_3$ MARTIN LILIENBLUM, YU KUMAGAI, Department of Materials, ETH Zurich, ALEXEI A. BELIK, International Center for Materials Nanoarchitectonics, NIMS, NAËMI LEO, NICOLA A. SPALDIN, MANFRED FIEBIG, Department of Materials, ETH Zurich — So far, it was believed that hexagonal (h-) $InMnO_3$ exhibit the same type of multiferroic order as the other compounds from the h-$RMnO_3$ family (R = Sc, Y, Dy - Lu), including, in particular, a unit-cell-tripling improper ferroelectric order. Here we present experimental evidence for the *absence* of ferroelectricity in hexagonal $InMnO_3$ based on three different techniques: x-ray diffraction (XRD), piezoresponse force microscopy (PFM) and optical second harmonic generation (SHG). XRD data are ambiguous because they can be described likewise by the non-ferroelectric $P\bar{3}c$ structure and by the ferroelectric $P6_3cm$ structure present in the other h-$RMnO_3$ compounds. However, PFM at room temperature and SHG measurements at low temperature uniquely reveal the absence of ferroelectric order in $InMnO_3$. We therefore propose that $InMnO_3$ exhibits antiferrodistortive, but non-ferroelectric order according to the $P\bar{3}c$ symmetry. Density functional calculations show that the relative energy between the $P\bar{3}c$ and $P6_3cm$ structures is determined by a competition between electrostatic and covalency effects, with an *absence* of covalency favoring the ferroelectric structure.

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