

A Room Temperature Polar And Weak-Ferromagnetic Oxide With Low Dielectric Loss

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Single-phase materials that are simultaneously ferroelectric and ferromagnetic at room temperature are promising for non-volatile random access memory devices. Perovskite BiFeO₃ which crystallizes in the polar rhombohedral structure (R3c), is ferroelectric and antiferromagnetic at room temperature. Here, we report a family of perovskite oxides in the BiFeO₃ – Bi_{2/3}TiO₃ – ATiO₃ (where A²⁺ = Ca²⁺, Sr²⁺, Ba²⁺) ternary phase diagram that is polar as well as weak ferromagnetic. We achieved nearly pure A-site bismuth-based perovskite phase Bi_{0.9167}R_{0.075}Fe_{0.9}Ti_{0.1}O₃ that crystallizes in the space group R3c similar to BiFeO₃ as corroborated by powder X-ray and neutron diffraction analysis. Their polarity was confirmed by second harmonic generation (SHG) experiments. Room-temperature powder neutron diffraction confirms G-type antiferromagnetic ordering consistent with weak ferromagnetism that onsets at T_N = 557 K. These perovskites show a low dielectric loss, and the electrical response is dominated by grain contributions below 723 K.