

NEW ORTHORHOMBIC MULTIFERROICS

$$R_{1-x}Y_xMnO_3 \quad (R = Eu, Gd)$$

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A competition of exchange interactions in orthorhombic manganites $R\text{MnO}_3$ induced by decreasing of the rare-earth ion ionic radii causes a sinusoidal antiferromagnetic ordering resulting in appearance of electric polarization below incommensurate-commensurate (IC-C) transition at $T_{lock} < T_N \sim 45K$. In this work we have realized the tendency to form multiferroic states in the single crystals of substituted compounds $Eu_{1-x}Y_xMnO_3$ ($0.2 \leq x \leq 0.5$) and $Gd_{1-y}Y_yMnO_3$ ($0 \leq y \leq 0.2$). While slightly substituted ($x \leq 0.1$) compounds exhibited a spontaneous transition from the IC to the canted antiferromagnetic (CAF) state at $T_{CA} < T_N$, the IC-C phase transition at $T_{lock} = 30K$ was observed for $x=0.2$, followed by the transition to the CAF phase at $T_{CA} \sim 22K$. For $x \geq 0.3$ and $y \geq 0.05$ only the IC-C transitions were found while the CAF phase disappeared at all. Various phase transitions were observed in the pulsed magnetic fields up to 250 kOe along a, b, c-axes by magnetization, magnetostriction and electric polarization measurements. The polarization showed a strong dependence on a preliminary poling in an electric field $E \sim 1500 \text{ V/cm}$ that indicated on an existence of a spontaneous electric polarization below T_{lock} , which was suppressed by $H \parallel c$ or changed by $H \parallel a, b$.

13.4 cm

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9.7 cm