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Heterostructured ceramic materials based on PZT-N-CFO compounds

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Abstract

Multiferroic composites are currently one of the hot research topics [1]. A great research effort is in progress to improve the fabrication of PZT–CoFe$_2$O$_4$ (PZT–CFO) composites due to the excellent piezoelectric properties showed by the PZT material class and the large magnetostrictive coefficient of the CFO. Unfortunately unwanted reactions occur during densification of PZT–CFO materials at 1100-1200 °C. They are promoted by initial PbO loss that is calculated through XRD analysis, considering the amount of ZrO$_2$ and variation of perovskite’s tetragonality. The resulting titanias reacts with CFO to form cobalt titanate [2].

The microstructure of the composites at 26-81 mol% CFO content was thoroughly investigated; the CFO grain size distribution can be mono- or bi-modal and limited grain growth (240 nm).

Results

The high coercivity (789 Oe) shown by these composites is correlated to the good reactions occur during densification of PZT–CFO materials at 1100-1200 °C. They are due to the excellent piezoelectric properties showed by the PZT material class and the large magnetostrictive coefficient of the CFO. Unfortunately unwanted reactions occur during densification of PZT–CFO materials at 1100-1200 °C. They are promoted by initial PbO loss that is calculated through XRD analysis, considering the amount of ZrO$_2$ and variation of perovskite’s tetragonality. The resulting titanias reacts with CFO to form cobalt titanate [2].

The microstructure of the composites at 26-81 mol% CFO content was thoroughly investigated; the CFO grain size distribution can be mono- or bi-modal and limited grain growth (240 nm).

Discussion

Reactions due to the PbO loss at the PZT/CFO interfaces [2]

1°) Pb(Zr$_{0.52}$Ti$_{0.48}$)O$_3$ → fPbO + (1-f)Pb(Zr$_{0.52}$Ti$_{0.48}$)O$_3$ + 0.52(1 - y + fy)ZrO$_2$ + 0.48(1 - z + fz)TiO$_2$

2°) Displacement reaction [2, 4]:

\[
\text{TiO}_2 + \text{CoFe}_2\text{O}_4 \rightarrow \text{CoTiO}_3 + \text{Fe}_2\text{O}_3
\]

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References