Supplementary information

High quality samples of La-substituted BiFeO₃ prepared by mechanosynthesis

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**Figure S1.** Diffraction patterns at different milling times of the solids obtained after milling under oxygen (7 bar) the stoichiometric amounts of the single oxides necessary for the composition Bi$_{0.93}$La$_{0.07}$FeO$_3$.

**Figure S2.** Diffraction patterns at different milling times of the solids obtained after milling under oxygen (7 bar) the stoichiometric amounts of the single oxides necessary for the composition Bi$_{0.85}$La$_{0.15}$FeO$_3$.
Figure S3. Diffraction patterns at different milling times of the solids obtained after milling under oxygen (7 bar) the stoichiometric amounts of the single oxides necessary for the composition Bi$_{0.70}$La$_{0.30}$FeO$_3$.

Figure S4. Diffraction patterns at different milling times of the solids obtained after milling under oxygen (7 bar) the stoichiometric amounts of the single oxides necessary for the composition Bi$_{0.55}$La$_{0.45}$FeO$_3$. 

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**Figure S5.** Diffraction patterns at different milling times of the solids obtained after milling under oxygen (7 bar) the stoichiometric amounts of the single oxides necessary for the composition Bi$_{0.40}$La$_{0.60}$FeO$_3$.

**Figure S6.** Diffraction patterns at different milling times of the solids obtained after milling under oxygen (7 bar) the stoichiometric amounts of the single oxides necessary for the composition Bi$_{0.20}$La$_{0.80}$FeO$_3$. 
Figure S7. Diffraction patterns at different milling times of the solids obtained after milling under oxygen (7 bar) the stoichiometric amounts of the single oxides necessary for the composition LaFeO$_3$.

Figure S8. SEM micrographs corresponding to powders obtained after milling the single oxides necessary for the composition Bi$_{0.93}$La$_{0.07}$FeO$_3$. Micrographs were taken after milling (a) 0.5 h, (b) 1 h, (c) 3 h, (d) EDX spectrum of the product shown in (c).
Figure S9. SEM micrographs corresponding to powders obtained after milling the single oxides necessary for the composition Bi$_{0.85}$La$_{0.15}$FeO$_3$. Micrographs were taken after milling (a) 0.5 h, (b) 1.5 h, (c) 3 h, (d) EDX spectrum of the product shown in (c).

Figure S10. SEM micrographs corresponding to powders obtained after milling the single oxides necessary for the composition Bi$_{0.70}$La$_{0.30}$FeO$_3$. Micrographs were taken after milling: (a) 0.25 h, (b) 1 h, (c) 2 h, (d) EDX spectrum of the product shown in (c).
Figure S11. SEM micrographs corresponding to powders obtained after milling the single oxides necessary for the composition Bi$_{0.55}$La$_{0.45}$FeO$_3$. Micrographs were taken after milling: (a) 0.5 h, (b) 1 h, (c) 2 h, (d) EDX spectrum of the product shown in (c).

Figure S12. SEM micrographs corresponding to powders obtained after milling the single oxides necessary for the composition Bi$_{0.40}$La$_{0.60}$FeO$_3$. Micrographs were taken after milling: (a) 0.5 h, (b) 1 h, (c) 2 h, (d) EDX spectrum of the product shown in (c).
Figure S13. SEM micrographs corresponding to powders obtained after milling the single oxides necessary for the composition $\text{Bi}_{0.20}\text{La}_{0.80}\text{FeO}_3$. Micrographs were taken after milling: (a) 0.25 h, (b) 1 h, (c) 1.5 h, (d) EDX spectrum of the product shown in (c).

Figure S14. SEM micrographs corresponding to powders obtained after milling the single oxides necessary for the composition $\text{LaFeO}_3$. Micrographs were taken after milling: (a) 0.5 h, (b) 1 h, (c) 2 h, (d) EDX spectrum of the product shown in (c).
Figure S15. Diffraction pattern corresponding to the sample Bi$_{0.93}$La$_{0.07}$FeO$_3$ obtained after milling the single oxides for 3 hours, and heated to 800°C (dots). The solid lines are the results of the Rietveld refinement. The inset shows a detail of the refinement in the range 20-45° where the maxima peaks are observed.

Figure S16. Diffraction pattern corresponding to the sample Bi$_{0.85}$La$_{0.15}$FeO$_3$ obtained after milling the single oxides for 3 hours, and heated to 800°C (dots). The solid lines are the results of the Rietveld refinement. The inset shows a detail of the refinement in the range 20-45° where the maxima peaks are observed.
Figure S17. Diffraction pattern corresponding to the sample Bi$_{0.55}$La$_{0.45}$FeO$_3$ obtained after milling the single oxides for 2 hours, and heated to 800ºC (dots). The solid lines are the results of the Rietveld refinement. The inset shows a detail of the refinement in the range 20-45º where the maxima peaks are observed.

Figure S18. Diffraction pattern corresponding to the sample Bi$_{0.40}$La$_{0.60}$FeO$_3$ obtained after milling the single oxides for 2 hours and heated to 800ºC (dots). The solid lines are the results of the Rietveld refinement. The inset shows a detail of the refinement in the range 20-45º where the maxima peaks are observed.
**Figure S19.** Diffraction pattern corresponding to the sample Bi$_{0.20}$La$_{0.80}$FeO$_3$ obtained after milling the single oxides for 2 hours and heated to 800°C (dots). The solid lines are the results of the Rietveld refinement. The inset shows a detail of the refinement in the range 20-45° where the maxima peaks are observed.

**Figure S20.** Diffraction pattern corresponding to the sample LaFeO$_3$ obtained after milling the single oxides for 2 hours and heated to 800°C (dots). The solid lines are the results of the Rietveld refinement. The inset shows a detail of the refinement in the range 20-45° where the maxima peaks are observed.
Figure S21. Diffraction pattern corresponding to the sample Bi$_{0.70}$La$_{0.30}$FeO$_3$ obtained after milling the single oxides for 2 hours and heated to 800°C (dots). The refinement of the pattern with Jana2006 in LeBail pattern match mode was performed considering the superspace group Imma(00γ)s00. The inset shows a detail of the refinement in the range 26-42°. The red arrows indicate the satellite peaks not fitted by this super structure.
Figure S22. Rietveld refinement of the pattern of the sample Bi$_{0.70}$La$_{0.30}$FeO$_3$ with Jana2006 in LeBail pattern match mode considering the superspace group Pn2$_1$a(00$\gamma$s)00. The inset shows a detail of the refinement in the range 26-42º. All satellite peaks are fitted by this super structure.
Figure S23. Full Rietveld refinement of the pattern of the sample Bi$_{0.70}$La$_{0.30}$FeO$_3$ with Jana2006 considering the superspace group Pn2$_1$a(00$\gamma$)s00.
Figure S24. Detail of the XRD patterns measured at different temperatures (between 320°C and 360°C) for Bi$_{0.70}$La$_{0.30}$FeO$_3$. From 350°C the double peak at about 22.5° transforms to a single peak and a new peak at 25.3° appears. The new phase can be indexed as Pnma, as was observed for compositions $x \leq 0.15$ above T$_C$. Other phase transitions at higher temperatures were not observed.
Figure S25. Magnetic field dependence of the magnetization at 5 K and 300 K for BiFeO$_3$ nanoparticles.
Figure S26. (a) Hysteresis loops obtained at 300 K for Bi$_{1-x}$La$_x$FeO$_3$ samples with $x= 0, 0.02, 0.07$ and $0.15$. (b) Zoom of the hysteresis loops.