Comment on: "Ferroelectricity of single-crystalline, monodisperse lead zirconate titanate nanoparticles of 9 nm in diameter" [Appl. Phys. Lett. 85, 2325 (2004)]

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The authors Seol *et al.*[1] report on the fabrication and characterization of thin films made of monodisperse and perovskite particles of 9 nm in diameter and claim to have observed ferroelectricity. The claims of this paper are remarkable but hardly justified. We would like to comment on several issues:

(a) Figure 2 in Ref. 1 does not show polarization saturation for PZT. Thus a more conservative interpretation is that it results from a dissipative dielectric capacitor. This is confirmed in Fig. 3, where the authors plot the remnant polarization and the coercive field versus maximum electric field and obtain a linear dependence in both cases. It is not clear why both remnant polarization and coercive field become zero at about 400 kV/cm and 300 kV/cm, respectively. However, significant leakage current simply does not develop below ~300 kV/cm.

(b) Aggregated ferroelectric nanograins as measured by the authors are electrostatically coupled. Roelofs *et al.*[2] showed coupling of ferroelectric domains across grain boundaries in $PbTiO_3$ polycrystalline thin films. A distinction between isolated and aggregated nanograins is therefore mandatory.

In conclusion, the electric properties reported in Ref. 1 of 9 nm "PZT" grains can be solely attributed to a dissipative dielectric capacitor without ferroelectric properties. This does not exclude the possible presence of ferroelectricity. However, it requires a more sophisticated investigation to pinpoint that claim. The success of having produced 9 nm grains that are possibly PZT deserves attention but requires much more investigation of the structure before any claims can be made about ferroelectric properties. Raman and XRD studies as quoted by the authors[3,4] or *I*-*V* curves can certainly provide valuable insight.

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