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Electrical properties and dielectric responses in rutile-TiO_2-based ceramics

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Colossal dielectric responses in rutile-TiO_2-based ceramics were investigated. Very high dielectric performance with ultra-high dielectric permittivity ($\varepsilon' \approx 10^3 - 10^6$) and very low loss tangent ($\tan(\delta) < 0.05$) over wide frequency and temperature ranges were achieved by co-doping with M^{3+} and N^{5+} ions. Good temperature stability of $\varepsilon\prime$ was also obtained. Electron-pinned defect-dipoles, grain boundary response, surface-barrier layer and electrode effects have a great influence on the overall dielectric properties of rutile-TiO_2-based ceramics. X-ray photoelectron and Raman spectroscopy analyses were carried out to describe the origin(s) of the colossal permittivity. Impedance spectroscopy was used to study the electrical responses of the grains and grain boundary.

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