Nanoscaled ferroelectric (pseudo)-binary oxide thin film for energy storage supercapacitors

Luís S. Marques,[1,2*] Corneliu Ghica,[3] Bertrand Vilquin,[4] José P. B. Silva[1,2]

[1]Physics Center of Minho and Porto Universities (CF-UM-UP), University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal

[2]Laboratory of Physics for Materials and Emergent Technologies, LapMET, University of Minho, 4710-057 Braga, Portugal

[3]National Institute of Materials Physics, 077125 Magurele, Romania

[4]Ecole Centrale de Lyon, INSA Lyon, CNRS, Universite Claude Bernard Lyon 1, CPE Lyon, INL, UMR5270, 69130 Ecully, France

*presenting author e-mail: lsam@fisica.uminho.pt

The NanOx4EStor project (Nanoscaled Ferroelectric (Pseudo)-Binary Oxide Thin Film Supercapacitors for Flexible and Ultrafast Pulsed Power Electronics) aims to develop innovative, cost-effective, high-throughput methods for fabricating advanced dielectric capacitors. These capacitors, based on wake-up-free (pseudo-)binary oxide thin films, are produced through physical vapor deposition (PVD) processes and optimized for superior ferroelectric and energy storage (ES) properties using (i) strain, (ii) interface, and (iii) dead-layer engineering techniques.
Here, we will present the recent advances in the NanOx4EStor project, which has led already to 12 publications in high impact factor scientific journals and 32 conference presentations. The project explores emergent antiferroelectric and ferroelectric $Hf_xZr_{1-x}O_2$ thin films (where x varies from 0 to 1), grown by sputtering and pulsed laser deposition techniques. While antiferroelectric ZrO_2-based capacitors exhibit an energy storage density up to 84 J/cm^3, with an efficiency of 75%, epitaxial ferroelectric La:HfO_2-based capacitors can show an energy storage density higher than 130 J/cm^3, with an efficiency close to 70%. Both results are among the highest values reported for antiferroelectric and ferroelectric fluorite-structured materials and were achieved in the framework of this project.
Additionally, several other studies are highlighted reporting on the phase stability, switching dynamics, ferroelectric properties optimization, as well as about novel heterostructures enabled by the technology developed in this project.

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