NanOx4EStor

Nanoscaled ferroelectric (pseudo)-binary oxide thin film supercapacitors for flexible and ultrafast pulsed power electronics

At a Glance

Funded under: M-ERA.NET3

Overall budget: € 642.822,00

Duration: 4 September 2022 – 3 September 2025

Coordinated by: University of Minho, Portugal

NanOx4EStor is implemented through the Joint Call 2021 of M-ERA.NET3, cofunded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 958174.

The Project

The main goal of the **NanOx4EStor** project is to develop innovative and cost effective high-throughput technologies for the fabrication of advanced supercapacitors based on wake-up free (pseudo-)binary oxide thin films, fabricated by physical vapour deposition (PVD) processes, with optimized ferroelectric and energy storage (ES) properties through (i) strain, (ii) interface and (iii) dead-layer engineering.

Consortium

University of Minho (UMinho), Portugal

National Institute of Materials Physics (NIMP), Romania

École Centrale de Lyon (ECL), France

Dissemination

Project website:
https://inl.cnrs.fr/projects/nanox4estor/

LinkedIn Group
https://www.linkedin.com/groups/9260371/

ResearchGate
https://www.researchgate.net/project/Nanoscaled-ferroelectric-pseudo-binary-oxide-thin-film-supercapacitors-for-flexible-and-ultrafast-pulsed-power-electronics

Publications

2. J. P.B. Silva, M. C. Istrate, M. Hellenbrand, A. Jan, M. T. Becker, J.anna Symonowicz e, Fábio G. Figueiras f, V. Lenzi, M. O. Hill, C. Ghica, K. N. Romanyuk, M. J.M. Gomes, G. Di Martino, L. Marques, J. L. MacManus-Driscoll, "Ferroelectricity and negative piezoelectric coefficient in orthorhombic phase pure ZrO_2 thin films", Applied Materials Today 30, 101708 (2023).

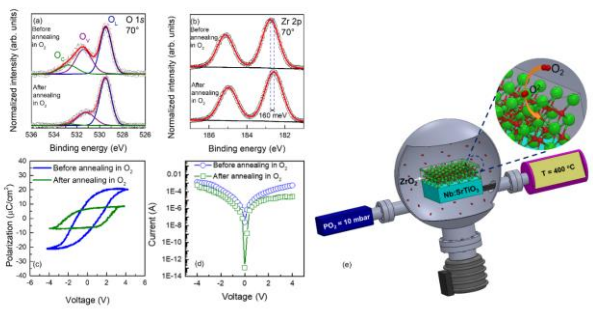
1. V. Lenzi, J. P. B. Silva, B. Šmíd, V. Matolín, C. M. Istrate, C. Ghica, J. L. MacManus-Driscoll, L. Marques, "Ferroelectricity induced by oxygen vacancies in rhombohedral ZrO_2 thin films" Energy & Environmental Materials (2022), In press. Doi: 10.1002/eem2.12500.

Conference presentations and proceedings

3. V. Lenzi, J. P. B. Silva, L. Marques, Ferroelectric phases in epitaxial ZrO_2 thin films achieved by substrate orientation control. E-MRS 2022 Fall Meeting in Warsaw, Poland (19–22 September 2022).
2. B. Vilquin, Influence of the electrode interface on the properties of ferroelectric $HfZrO_2$. Oral presentation at Novel High-k Application Workshop 2022 in Dresden, Germany (12-13 September 2022).
1. J. P. B. Silva, Ferroelectric orthorhombic and rhombohedral phases in ZrO_2 thin films. Oral presentation at Novel High-k Application Workshop 2022 in Dresden, Germany (12-13 September 2022).

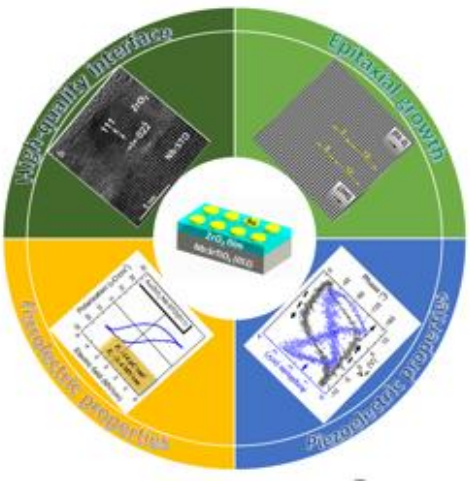
Ferroelectricity induced by oxygen vacancies in rhombohedral ZrO_2 thin films

The ongoing debate on the role of oxygen vacancies on stabilizing the rhombohedral phase, but also its impact on the ferroelectric polarisation in the ZrO_2 films has, to a large extent, been resolved by the recent work of NanOx4EStor partners UMinho and NIMP who demonstrated that by reducing the oxygen vacancies concentration the ferroelectric polarization also decreases. The experiments were supported by Density Functional Theory calculations. The work has also the contribution of Judith L. MacManus-Driscoll at the University of Cambridge in the UK, member of the project Advisory Board.



Epitaxial stabilization of ferroelectric orthorhombic ZrO_2 films with negative piezoelectric coefficient

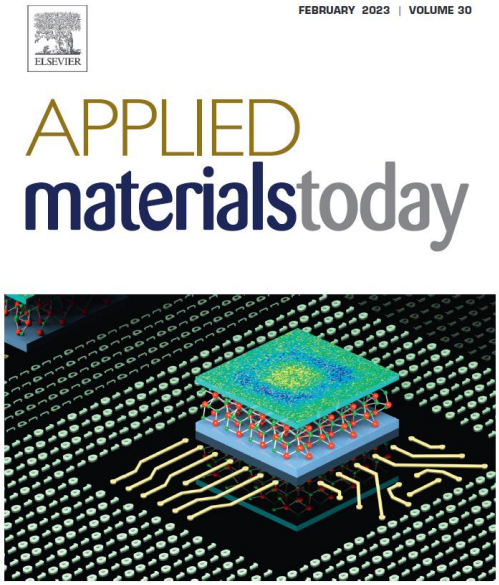
A new approach for epitaxial stabilization of ferroelectric orthorhombic ZrO_2 films by ion-beam sputtering, an industrial compatible process, is demonstrated in the recent work of NanOx4EStor partners UMinho and NIMP. Contrary to the films grown on (001)-Nb:$SrTiO_3$ substrates, films grown on (011)-Nb:$SrTiO_3$ substrates form an epitaxial pure orthorhombic phase, showing a wake-up free ferroelectric behavior. The work benefited also from the contribution of the group lead by Judith L. MacManus-Driscoll at the University of Cambridge in the UK, who is also member in the project Advisory Board.



NanOx4EStor research featured in the News section of Materials Today

The research work about the stabilization of epitaxial ferroelectric orthorhombic ZrO_2 films with negative piezoelectric coefficient published in Applied Materials Today [Silva et al., Applied Materials Today 30 (2023) 101708, https://doi.org/10.1016/j.apmt.2022.101708] was highlighted by the News section of Materials Today and can be consulted at: https://www.materialstoday.com/electronic-properties/news/zr-oxide- thin-films-promise-next-generation-memory/

NanOx4EStor research highlighted as the front cover page of Applied Materials Today



Dr. José Pedro Basto da SILVA and his student Nuno ESTROCIO e SILVA from University of Minho visited Ecole Centrale de Lyon (ECL) from Jan. 30th to Feb. 3rd 2023 in the framework of M-ERA.NET project Nanox4EStor. The purpose of his stay was to attend a PhD defense, to give a lab seminar on research activities and to perform electrode depositions and characterizations of ZrO_2 and $HfZrO_2$ films in clean-room environment.

Dr. Jordan Bouaziz arrived to Ecole Centrale de Lyon (ECL) on March 1st 2023 for a post-doc position in the framework of M-ERA.NET project Nanox4EStor.