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Department	School of Engineering and the Built Environment
Supervisors	Zhilun Lu, Dongyang Sun
Funding Status	Funded PhD Project (Worldwide)
Application Deadline	14/04/2022
Project Title	Development of Lead-free Ceramics for Dielectric Energy Storage Capacitors

PROJECT DESCRIPTION

With the environment and climate deteriorating, it is vital to speed the development of reliable energy storage devices that will allow renewable energy to be used indefinitely [1]. Chemical energy storage (e.g., batteries) and physical energy storage (e.g., capacitors) are the two primary types of energy storage technologies.

As capacitors, dielectrics aid in electrostatic energy storage and are critical energy storage components [2]. Dielectric capacitors (electrostatic energy storage capacitors) with high power densities are critical components of electrical and electronic systems for energy storage [3]. Dielectric capacitors are the most widely made and used capacitors, with trillions produced each year, and have countless applications, such as smart grids, electronic circuits, electric vehicles, wearable electronics, etc [4-5]. However, boosting their energy densities has been a long-standing difficulty. Improving energy density and other properties of dielectric capacitors will make them more competitive and complimentary to batteries in energy storage applications.

The aim of the project is to improve the energy density of ceramic capacitors without compromising their thermal stability. This project will combine microstructure characterisation and performance testing to conduct a systematic study of the defect chemistry, phase transition, conduction, and polarisation mechanisms of ceramic-based energy storage materials; and to develop a new research guide for the design and development of superior lead-free energy storage materials.

Academic qualifications

A first degree (at least a 2.1) ideally in Materials, Chemistry or closely related area with a good fundamental knowledge of functional materials.

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

Essential attributes:

- Experience of fundamental ceramic fabrication or property characterization
- Competent in basic laboratory skills, especially solid state reaction
- Knowledge of materials science and/or chemistry
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

Postgraduate training in Materials Science.

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Indicative Bibliography	[1] I. Hadjipaschalis, A. Poullikkas, V. Efthimiou, Renewable and Sustainable Energy Reviews 13 (2009) 1513. [2] Z. Yao, Z. Song, H. Hao, Z. Yu, M. Cao, S. Zhang, M.T. Lanagan, H. Liu, Advanced Materials 29 (2017) 1601727. [3] X. Hao, Journal of Advanced Dielectrics 03 (2013) 1330001. [4] K. Zou, Y. Dan, H. Xu, Q. Zhang, Y. Lu, H. Huang, Y. He, Materials Research Bulletin 113 (2019) 190. [5] L. Yang, X. Kong, F. Li, H. Hao, Z. Cheng, H. Liu, J.-F. Li, S. Zhang, Progress in Materials Science 102 (2019) 72.
Funding notes	This is an unfunded position.
Enquiries	For informal enquiries about this PhD project, please contact Z.Lu@Napier.ac.uk
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process

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