Funded PhD Student Position

Advanced Manufacturing of Solid-State Devices and ICs for Microwave Applications

Microwaves and Antenna Engineering Group, Institute of Sensors, Signals and Systems, School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, UK.

Project Description

Microwave and wireless systems require electronic reconfigurability to satisfy ever increasing spectrum requirements and to ensure functional agility at a better economic outlay. Present electronic reconfigurability mostly relies on conventional active semiconductor solutions based on metalloid and post transition metals, and their composites (e.g., Si/Ge/Te/Ga/As, etc.), that has certain technical limitations as well as some economic and environmental implications.

In the proposed PhD research, the studentship is focused on exploring novel conventional and non-conventional methods for development and manufacture of linear and non-linear solid-state devices for microwave applications. The proposed methodology is based on solution processable semiconducting and conducting polymers and their composites, that has several advantages in comparison to conventional materials and methods like ease of manufacture – like low temperature printability, lower cost, etc. The research will involve technology development of active and passive two and three terminal solid-state devices, analysing novel techniques for rapid manufacture of the same, and related physical/mathematical modelling. This is a highly experimental activity and will focus on hybrid ambient techniques for device manufacture and standard clean room-based microfabrication, simultaneously, and undertake microwave devices and circuit design as well as material engineering in a broad perspective of tailoring material composites for intended microwave performance. Both hybrid microwave integrated circuits alongside with standalone discrete microwave devices with electronic reconfigurability will be a target of this study.

The recruited student is expected to immediately start working on the above, based on the strong background framework and plan of action laid by the supervisor Dr. Jayakrishnan Purushothama, and will make use of the excellent state-of-the art resources available at the School of Engineering and Physical Sciences, at Edinburgh campus. The resources include advanced microwave engineering and wireless communication laboratory (with micro probing facilities, modern VNAs, VSGs, VSAs, source-meters, anechoic chambers, and similar), microfabrication clean room, sophisticated imaging & material analysis tools like SEM/EDAX, XRD, high-resolution optical microscopes, semiconductor parameter analysers, wet-chemistry labs, etc., to mention a few. This research and the supervisor have close collaboration and will be supported by several renown faculty and industrialists at Heriot-Watt Univ., UK, and abroad.

Scholarship: £17,668 P.A. + tuition fees waived (eligible students are exempted from income and council taxes).

Duration: 42 Months**.**

Location: Heriot-Watt University, Edinburgh Campus, UK.

Deadline: rolling advertisement continues till the position is filled.

Supervision team

Dr. Jayakrishnan M. Purushothama, Assistant Professor, Heriot-Watt University will be the first supervisor of the student throughout this PhD program.

Release date: July 2023.

Dr. Yuan Ding, Associate Professor, Heriot-Watt University, with exemplary experience and expertise in microwave engineering and wireless communications will be a co-supervisor and support the student in allied areas.

Prof. Marc Desmulliez, Professor, Heriot-Watt University, an eminent academician, and scientist, with cross disciplinary expertise in microwave engineering, nature inspired engineering, novel manufacturing methods, and similar will co-supervise the student in relevant domains.

To apply please send your motivation letter, CV, and recommendation letters (optional) to jm2040@hw.ac.uk. We highly encourage aspirants to reach out for any discussions or queries.

Candidate description and eligibility

A highly motivated candidate with an MSc/BEng degree or equivalent in electrical engineering, with a strong passion for RF/microwave engineering, microfabrication techniques, solid-state physics, and material science is sought herewith. Desirable: in addition to above qualifications, interest and expertise in chemistry/material-science would be advantageous.

Funding notes

Essentially UK based students are supported in this scheme, however international students are also encouraged to apply and maybe considered in absence of UK students with a good match to the project. International students please see English language requirements for EU/overseas applicants: https://www.hw.ac.uk/study/entry/english-language-requirements.htm

Final terms and conditions of the studentship is subject to be confirmed with the Heriot-Watt University HR department once the final shortlisting and interview is held.

Other benefits: Heriot-Watt University Edinburgh campus is a vibrant social community in addition to great research and learning atmosphere, and provides several outstanding facilities, including for healthcare, sports, and social well-being. Please visit for more information: https://www.hw.ac.uk/uk/edinburgh/facilities.htm

Relevant references

1. J. Methapettyparambu Purushothama, S. Lopez-Soriano, A. Vena, I. Susanti, B. Sorli, and E. Perret, “Electronically Rewritable Chipless RFID Tags Fabricated Through Thermal Transfer Printing on Flexible PET Substrates”, IEEE Transactions on Antennas and Propagation, vol. 69, no. 4, pp. 1908-1921, April 2021. Doi: https://doi.org/10.1109/TAP.2020.3030965
2. López-Soriano, S., Methapettyparambu Purushothama, J., Vena, A., and Perret, E., “CBRAM technology: transition from a memory cell to a programmable and non-volatile impedance for new radiofrequency applications”, Nature Scientific Reports 12, 4105 (2022). Doi: https://doi.org/10.1038/s41598-022-08127-x
3. M. P. Jayakrishnan, A. Vena, A. Meghit, B. Sorli, and E. Perret, “Nafion based fully passive solid-state conductive bridging RF switch”, in IEEE Microwave and Wireless Components Letters, vol. 27, no. 12, pp. 1104-1106, Dec. 2017. Doi: https://doi.org/10.1109/LMWC.2017.2764741
4. Prabir Mahato, Methapettyparambu Purushothama Jayakrishnan, Arnaud Vena, Etienne Perret, “Planar CBRAM devices using non-cleanroom techniques as RF switches”, Appl. Phys. A 129, 438 (2023). https://doi.org/10.1007/s00339-023-06687-x