Memtransistors for Brain-Inspired Computing

Fully funded 4-year PhD studentship, London Centre for Nanotechnology, UCL
Primary Supervisor: Dr Antonio Lombardo | **Secondary Supervisor:** Prof. Tony Kenyon
Start date: October 2027
Applications: reviewed on a rolling basis until a suitable candidate is found, so early applications are strongly encouraged.

The challenge

Artificial intelligence is transforming science and society, but its energy demand is growing at an unsustainable rate. A major cause lies in the architecture of conventional computers, where memory and processing are physically separated and data must be shuttled continuously between them. Neuromorphic (brain-inspired) computing takes a different approach. As in the brain, information is stored and processed in the same place, by networks of artificial neurons and synapses built directly in hardware. This can dramatically reduce the energy needed for tasks such as pattern recognition, learning and decision-making.

The project

Our group has recently shown that memristors (resistive memories) based on semiconductor–insulator structures, obtained by controlled oxidation of 2D layered semiconductors such as HfS_2, are highly promising building blocks for neuromorphic hardware. They combine low energy consumption, fast switching, environmental stability and multilevel programmability. When used to store the synaptic weights of a neural network, they deliver accuracy close to that of software running on GPUs, at a fraction of the energy (https://lombardo-lab.com/publications).

In this PhD you will take this technology from single devices to working systems. You will:

- develop memtransistors, which combine the non-volatile memory of a memristor with the gate control of a transistor, so that storage and addressing are provided by a single device
- design and build arrays and integrated circuits based on these devices, and use them to demonstrate hardware accelerators for neuromorphic computing
- integrate the devices with silicon CMOS, so that the accelerators are compatible with existing semiconductor technology

What you will do and learn

The project is primarily experimental, supported by modelling. You will work across the full chain from materials to systems: preparation and processing of 2D semiconductors, cleanroom nanofabrication, electrical characterisation, and finite-element and circuit simulations. You will present your work at international conferences and publish it in leading journals, and you will graduate with a combination of device, fabrication and circuit skills that is valued in both the semiconductor industry and academia, particularly in the field of neuromorphic computing.

Where you will work

You will join the Nanoelectronic Devices Group (https://lombardo-lab.com/), based at the London Centre for Nanotechnology (https://london-nano.com/) at UCL, and work alongside its PhD students and postdoctoral researchers. You will have access to the LCN's extensive nanofabrication facility (https://lcn-cleanroom.com/) and to the 2D Electronics Lab, which is equipped for advanced characterization of devices and systems at DC, RF, microwaves in a variety of operating conditions, including cryogenic and elevated temperatures.

The project is closely aligned with NeuroWare, the UK Innovation and Knowledge Centre for neuromorphic hardware (https://neuroware-ikc.com/). This will give you the opportunity to collaborate with leading academic and industrial researchers in the field.

Who we are looking for

You should have, or expect to obtain, a first or upper second-class degree (or equivalent) in electronic engineering, physics, materials science or a related discipline. A Master's-level qualification is desirable. Experience in nanofabrication, electrical characterisation, programming or circuit design is welcome but not essential: curiosity and enthusiasm for experimental work matter most.

Funding and eligibility

The studentship is funded for four years. It covers home tuition fees and a tax-free stipend matching the UKRI London rate, estimated at £24,522 per year for 2027/28. The exact figure may differ slightly and will be confirmed by UKRI and UCL in 2027, usually in spring. The studentship also includes funding for research expenses such as travels and consumables.

This studentship is open only to applicants who qualify as home students. You must meet at least one of the following criteria, together with the associated residency requirements:

- be a UK national
- be an Irish national
- have settled status

- have pre-settled status
- have indefinite leave to remain or enter

Full details are available online: https://www.ucl.ac.uk/study/student-finances/tuition-fees/your-tuition-fees/student-fee-status

How to apply

Informal enquiries are welcome: contact Dr Antonio Lombardo at **a.lombardo@ucl.ac.uk**. To apply, please send a CV, academic transcripts, the names of two referees and a short statement describing your motivation and your experience and background in the research area.

Suitable candidates will then be invited to submit a formal application via the UCL admissions webpage.

Equality, diversity and inclusion

As London's Global University, we know diversity fosters creativity and innovation and we are committed to equality of opportunity, to being fair and inclusive, and to being a place where we all belong. Our department holds an Athena SWAN Bronze award, in recognition of our long-term commitment and 'beacon' status in advancing gender equality. You can read more about our commitment to Equality, Diversity and Inclusion here: https://www.ucl.ac.uk/equality-diversity-inclusion.