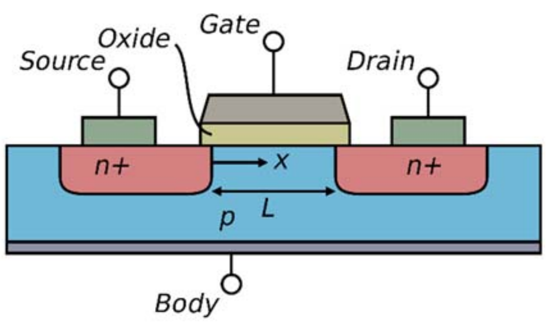
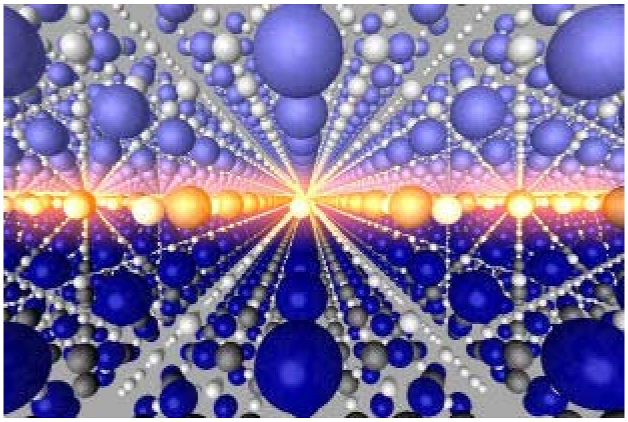
# BSc/MSc project

NanoElectronics Group www.nano-electronics.nl
Interfaces and Correlated Electron systems Group www.utwente.nl/tnw/ice

Title: Fabrication and measurement of fully oxide-based field-effect transistors
Supervisor: Pim Reith (PhD student NE/ICE)




*Schematic of a classic MOSFET transistor. Wikimedia Commons.*



*Artist impression of conduction at the $LaAlO_3$-$SrTiO_3$ interface, showing the 2DEL confined in a very narrow region. Courtesy of J. Mannhart, MPI Stuttgart.*

**Goal and motivation**

Oxide materials exhibit a wide range of physical phenomena, e.g. high-temperature superconductivity, ferroelectricity and -magnetism and extremely high dielectric constants, making them important candidates in the search for new functionality in electronics. The interface between the two insulators lanthanum aluminate ($LaAlO_3$, LAO) and strontium titanate ($SrTiO_3$, STO) hosts a highly conducting two-dimensional electron liquid (2DEL) and serves as a model system for oxide electronics. For example, it shows superconductivity below 300 mK with the characteristics of a high-temperature superconductor and possesses electrically tunable spin-orbit coupling, making it interesting for spintronic applications.

Oxide research, and LAO-STO interface systems in particular, is slowly moving from a scientific curiosity to more application-based research. It is therefore interesting to study the transistor structure made out of LAO-STO, to investigate how well it is suited for potential electronic applications.

**The assignment**

The MSc student will fabricate and measure field-effect transistors (FETs) using the 2DEL as a conduction channel and a gold top-electrode as a gate. The project will initially focus on micrometer-scaled devices, fabricated using photolithography and $AlO_x$ hard mask techniques. The student will design and fabricate their own structures and will measure them using techniques available at the NE and ICE groups.

Initial measurements will be done using a probe station, which allows for fast measurement of multiple structures at room temperature. Interesting characteristics include the carrier type, density and mobility, I-V characteristics, influence of the top-gate (threshold voltage for pinching off the channel, gain, etc.), leakage characteristics and the capacitance.

**Profile**

Students with preferential background in electrical engineering, physics, nanotechnology and material science are encouraged to apply.

**Graduating in NE**

As a student in NE you are a full group member and expected to give an active contribution to ongoing research. You are involved in specific aspects of research (device fabrication, measurements and analysis) and your work is likely to be part of a scientific publication. Besides you are also encouraged to participate in the regular social activities.

**Contact**

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