# Oxide Interface-Based Polymorphic Electronic Devices for Neuromorphic Computing

## Authors

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## Abstract

This paper demonstrates oxide-interface based polymorphic electronic devices with programmable transistor, memristor, and memcapacitor functionalities. These functionalities are achieved by manipulating the quasi-two-dimensional electron gas in LaAlO3/SrTiO3 heterostructures using lateral gates. A circuit using transistor and memcapacitor functionalities exhibits nonlinearity and short-term memory, suitable for reservoir computing. Another circuit using transistor and memristor functionalities demonstrates short- to long-term synaptic plasticity and logic operations with in-situ storage. The reconfigurable capabilities are shown to enable high-level decision-making tasks.

## Key Findings

* \* Demonstrated oxide-interface based polymorphic electronic devices functioning as transistors, memristors, and memcapacitors at room temperature.
* \* Achieved these functionalities by manipulating the quasi-two-dimensional electron gas in LaAlO3/SrTiO3 heterostructures using lateral gates.
* \* Implemented a reservoir computing system using a transistor-memcapacitor combination, showcasing nonlinearity and short-term memory.
* \* Developed a transistor-memristor integrated circuit for short- to long-term synaptic plasticity and logic operations with in-situ data storage.
* \* Showcased reconfigurable logic operations for high-level multi-input decision-making tasks.
* \* Presented a scalable, silicon-compatible, and energy-efficient single platform for oxide-based monolithic integrated circuits, advancing both polymorphic and neuromorphic computing.