# Polarization-Dependent Synaptic-like Electro-Optical Response in Ferroelectric Nematic Liquid Crystals

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In our work, we have functionalized a newly-developed class of stimuli-responsive materials, named ferroelectric nematic liquid crystals (FNLCs), for their potential application as neuromorphic hardware. The realization of neuromorphic hardware requires materials that can combine non-volatility, low power consumption, and stable analog memory [1]. To fulfill this demand, FNLCs are a promising candidate of materials which exhibit switchable polarization at electric fields as low as 0.1 V $\mu m^{-1}$, providing a unique platform for low-power optic and electronic applications [2]. FNLC-based devices face a key limitation: after reaching "saturation polarization (Ps)", the rapid relaxation occurs once the electric field is removed [3]. This loss of "remanent polarization (Pr)" arises from molecular elasticity and interfacial anchoring in FNLCs, causing dipoles to reorganize and cancel each other at zero field. To hurdle this challenge, FNLCs are integrated with semiconductors in a configuration that mimics the operation of a biological electric synapse, including long and short-term electro-optical responses. This synaptic behavior is enabled by our composite, suppressing the intrinsic polarization relaxation of FNLCs; our innovation allows for a 1.5 times higher memory and 90% signal retention based on an FNLC system, even after repeated cycles. Thus, we are able to generate ferroelectricity with long-lasting polarization response at low-voltage, thereby unlocking the use of FNLCs as synaptic elements in non-volatile memory applications.

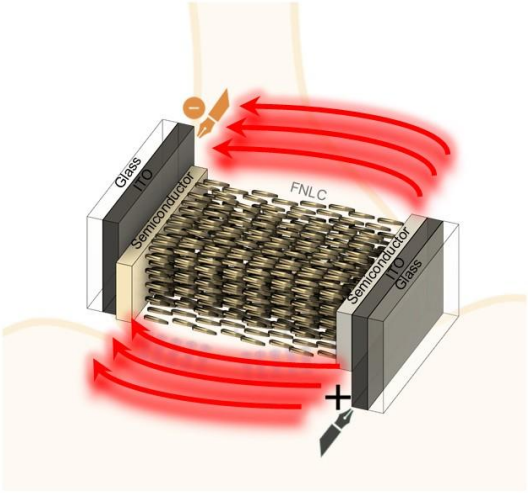


*Figure 1: Depiction of the FNLC device architecture with polar arrangements in the electric field.*

**References**

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