Ferroelectric $Hf_{0.5}Zr_{0.5}O_2$ on InAs at Cryogenic Temperatures

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Quantum computers could significantly scale up their qubit count with the aid of memory capable of functioning at cryogenic temperatures [1]. Moreover, the physical proximity of cryogenic memory to the qubits will reduce power and latency [2]. The inherent CMOS compatibility of Zr-doped HfO_2 (HZO) thin films coupled with its ability to be ferroelectric and non-volatile make it a promising candidate [3], [4].

The ferroelectric capacitor (FeCAP) was fabricated with undoped InAs as the bottom electrode. Owing to the high mobility of InAs, ferroelectric integration on InAs is promising for high frequency and mobility devices with neuromorphic applications [5]. 1.2 nm Al_2O_3 followed by 8 nm of $Hf_{0.5}Zr_{0.5}O_2$ is deposited using ALD preceded by a native oxide etch. TiN is deposited as the top electrode. The sample then underwent annealing for 30 s at 500°C post deposition to induce the ferroelectric phase in HZO.

The FeCAPs were characterized at different temperatures using an Agilent B1500 parameter analyzer. All devices were subjected to a wake up operation with a 1 kHz square wave before any measurements. From the P-E characteristics of the FeCAP, it is observed that similar remnant polarization can be obtained for the FeCAP at different temperatures ranging from room temperature down to 14 K. The FeCAP exhibits a $2P_r$ of 46.5 μC/cm^2 and 44.5 μC/cm^2 at RT and 14 K respectively.

By obtaining similar performance in terms of remnant polarization at cryogenic temperatures, ferroelectric HZO on InAs shows potential for cryogenic memory devices.