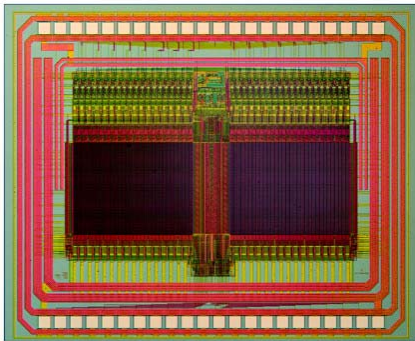


Molecular Beam Epitaxy (MBE) Growth of Multiferroic Oxides for Tunable Memory Devices

As rapid progress in the miniaturization of semiconductor electronic devices leads toward features smaller than 100 nanometers in size, device engineers and physicists are inevitably faced with the looming presence of quantum mechanics--that counterintuitive and sometimes mysterious realm of physics wherein wavelike properties dominate the behavior of electrons. We are being offered an unprecedented opportunity to define a radically new class of device that would exploit the counterintuitive phenomena of the quantum world to provide unique advantages over existing information technologies. One such phenomenon is a quantum property of the electron known as spin, which is closely related to magnetism. Devices that rely on an electron's spin to perform their functions form the foundation of *magnetoelectronics* (short for spin-based electronics), also known as *spintronics* (see adjacent figure). We fabricate heterojunctions of these ferromagnetic oxides with semiconductors for spin injection via tunneling. We intend to investigate the heteroepitaxial growth of epitaxial Fe_3O_4 with high spin polarization using a thin epitaxial oxide tunnel junction, such as MgO , that is compatible and lattice matched with the ferromagnetic half metallic oxide [41-43].



A magnetic Random Access Memory (RAM) chip developed by MOTOROLA for high speed low power memory applications. MRAMs are non-volatile and can retain information even after the power is turned off.

The REU fellows will be introduced in the use of state-of-the-art methods in thin film growth, nano-fabrication, and nano-characterization using electron and X-Ray microscopy. We expect the students to do thin film growth and material characterization of the sample they grow using MBE.

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 43. L. Farina, K. Lewis, C. Kurdak, S. Ghosh, and P. Bhattacharya, "Anomalous drag coupling between a thin superconducting film and a two-dimensional electron gas caused by radio frequency interference", submitted to *Physical Review B* (January 2004).