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***In situ* isotopic enrichment and growth of ^{28}Si for quantum information** KEVIN DWYER, Materials Science and Engineering, University of Maryland, JOSHUA POMEROY, NIST — Starting from natural abundance silane gas, we deposit ^{28}Si films enriched *in situ* to 99.9% in support of solid state quantum information systems. Isotopically enriched materials such as ^{28}Si are known to act as a "solid state vacuum" allowing for qubits with coherence (T_2) times of minutes. Quantum coherent devices rely on long T_2 times, but nuclear spin impurities are a major cause of decoherence. Isotopically enriching materials to eliminate stray nuclear spins (such as the 4.7% ^{29}Si in natural silicon) greatly improves coherence. Our objective is to produce silicon that is not only isotopically enriched, but chemically pure and defect free. We crack and ionize a natural abundance source gas, magnetically mass filter the ions in a beam line, and deposit the enriched material hyperthermal energies. In addition to our first ^{28}Si samples assessed by SIMS to be enriched to $> 99.9\%$, we previously implanted ^{22}Ne enriched at 99.4% (9.2% natural abundance) as proof of principle and have also grown ^{12}C films enriched at $>$ 99.996% (98.9% natural abundance). To our knowledge, no other effort is actively producing enriched solid silicon directly from natural abundance silane. Ongoing improvements are leading us towards our goal of ^{28}Si enriched to $> 99.99\%$ and epitaxial deposition.

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