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Challenges for Materials to Support Emerging Research Devices

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The 2004 International Technology Roadmap for Semiconductors (ITRS) Emerging Research Devices Chapter has highlighted a number of emerging memory and logic devices with potential for application to future computing technologies. Digital devices operate by representing one of the 2 or more possible values of a logic "state variable," and these values of the state variable are selected by the operation of the device responding to a stimulus. The operating characteristics of the device depend upon the materials and interface properties. Current state variables include: Charge transport and charge state, spin state, solid state phase, molecular charge transport state, quantum state (Qbit), flux quanta (RSFQ) field energy, and mechanical state. Devices that operate based on many of these states will need new materials, characterization and modeling techniques to measure and extract their properties at the nanometer scale. While many materials may be possible to synthesize with conventional deposition techniques, new chemical precursors or molecules may be required, but self assembly should be explored. As new nanometer scale materials are explored to fabricate these new device materials, existing metrology may need to couple with other stimuli to characterize the material and interface properties at these scales.

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