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Abstract for an Invited Paper
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Constructing a Computer from Molecular Components[1]

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Constructing a Computer from Molecular Components Research efforts directed toward constructing a molecular computer will be described in the context of recent developments in nanotechnology. Routes will be outlined from the synthesis of the basic building blocks such as wires and alligator clips, to the assembly of the processing functional blocks. Specific achievements include: (1) isolation of single molecules in alkane thiolate self-assembled monolayers and addressing them with an STM probe, (2) single molecule conductance measurements using a mechanically controllable break junction, (3) 30 nm bundles, approximately 1000 molecules, of precisely tailored molecular structures showing negative differential resistance with peak-to-valley responses far exceeding those for solid state devices, (4) dynamic random access memories (DRAMs) constructed from 1000 molecule units that possess 15 minute information hold times at room temperature, (5) demonstration of single-molecule switching events and (6) initial assemblies and programming of molecular CPUs in a NanoCell configuration that show room temperature electronic memory with days or electronic hold time, and the programming of logic gates such as AND, OR, NAND and NOR gates. Full silicon-molecule interfaces are used in the generation 3 NanoCell, as well as molecular FETs (MoleFETs). Finally, a molecular testbed has been developed that involves only semiconductor contacts (no metal contacts) to the molecules, thereby mitigating electromigration.

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