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Phase Change Memory and Thermoelectricity

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Ability to manufacture devices with < 20 nm critical features sizes is now enabling new technologies that compliment CMOS. Phase change memory (PCM) is a high-speed resistive non-volatile memory technology that has the prospect to be integrated on top of VLSI circuits, producing computer chips with large volume ($\sim$ 250 GB) of non-volatile memory in a single chip. This embedded storage will eliminate the need for additional computer memory (DRAM) or a motherboard, speeding up computer performance by >1000x for data intensive applications.

Phase change memory devices utilize glassy material which have a large resistivity contrast for their crystalline and amorphous phases. These materials can be rapidly and reversibly switched between the two phases by melting and freezing or by annealing above glass transition temperature using electric current ($\sim$ 1-10 MA/cm^2). As the temperature of a small volume is increased rapidly while generating a large thermal gradient ($\sim$ 10 K/nm), thrermoelectric effects play a significant role.