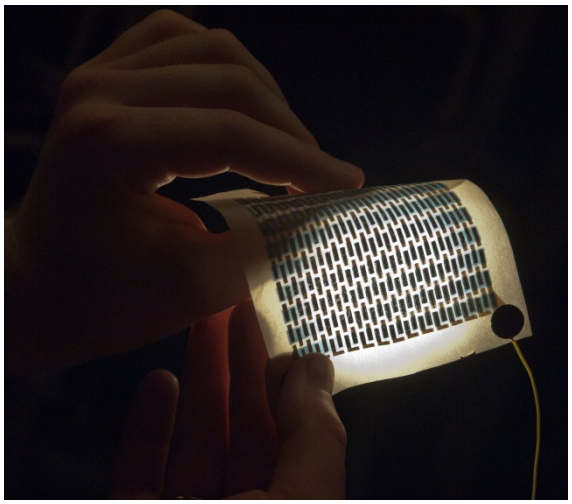
Miles C. Barr: Notable Inventions
Winner of the 2012 $30,000 Lemelson-MIT Student Prize

Bringing Solar Energy to the Masses

The challenge: Widespread adoption of conventional solar cells is currently limited by the high cost of fabrication, installation, and interconnection to other components. Rigid glass or silicon surfaces in their current designs represent a large fraction of the overall cost and restrict how and where they can be deployed.

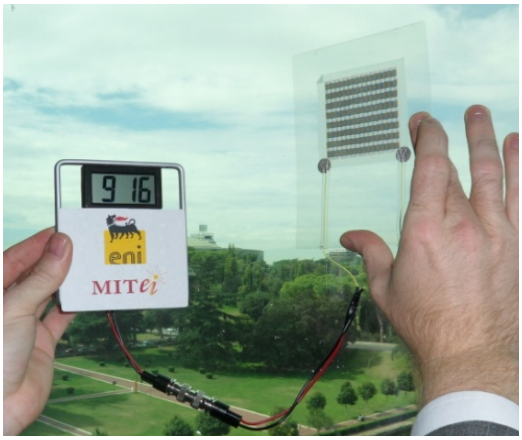


Solar cell fabricated by chemical vapor deposition on ordinary paper.

The opportunity: Miles C. Barr recognized that a paradigm shift to the design of solar cells was necessary for increased commercial applications and deployment of solar power. Barr set out with the goal of making solar energy harvesting structures low cost, lightweight, flexible, and compatible with everyday surfaces. He knew that this revolutionary technology could be enabled by a portfolio of individual innovations spanning alternative energy, chemistry, electrical engineering, and materials science.

The approach: Under the guidance of Professor Karen K. Gleason and Professor Vladimir Bulović at MIT, Barr began this transformative process using a technique called chemical vapor deposition (CVD) to fabricate organic photovoltaics. CVD uses reactive vapor precursors to form thin and flexible plastic films and is a unique method for fabricating organic photovoltaics because it is low temperature, solvent free, and it conforms easily over textured surfaces such as paper and textiles. Barr designed and incorporated these CVD films in various roles within the solar cell, including as electrodes, active layers that absorb light and encapsulants that protect the cell from exposure to outside elements such as water.

Barr also designed, constructed, and maintained a variety of custom CVD reaction chambers. These chambers are used to deposit various polymeric device layers and are optimized for producing solar cells on a variety of surfaces.



Integrated paper solar cell circuit powering an LCD clock.

The unique processing capabilities of CVD enabled Barr to fabricate solar cells directly on a variety of everyday surfaces, such as paper and textiles. Barr has demonstrated that the paper-based cells can be optimized to power common electronics – such as LCD displays – in ambient light. Barr's substitution of glass panel substrates with substrates like paper could reduce the cost of solar panel manufacturing and installation.

Barr's innovations have significant implications for solar power generation applications and deployment strategies. The ability to nondestructively fabricate flexible solar cells on common everyday surfaces inspires a near-term vision of a world where rapidly manufactured low-cost solar cells are seamlessly integrated into existing products and in formats that are pervasive in society.