Environmentally Responsive Building Envelopes: Light + Heat

Impact: One of the goals of green design is to precisely regulate the interior temperature of buildings relative to their energy consumption. The building envelope, a potential responsive interface capable of absorbing and reflecting the sun's energy, should be utilized to truly reduce a building's energy consumption. Light transmittance and solar heat gains must be managed efficiently, while glass and glazing selection play a key role in determining a building's overall thermal performance. Thermal performance requirements for fenestration products such as windows, doors and skylights that fill openings in a building envelope must be integrated with the building's heating and cooling systems. Polarized filters have long been used to reduce glare and heat gain from windows. In this project, shape memory alloy (SMA) elements will be used to optically control the amount of light allowed to pass through glazing without the complexity of sensing technology.

Project Overview: The project team will consult with industry representatives on how to best design environmentally responsive building envelope prototypes, which will be further tested and evaluated. Glazing elements will be designed to have desirable energy and optical performance characteristics, which will help ensure both thermal and visual occupant comfort. Including SMA elements will contribute to the development of an ambient, adaptive glazing element that will allow exterior light to enter through polarized filters that will trigger the SMA, which will then mobilize to reduce solar heat gain, lower the building's cooling load and, thereby, reduce overall energy consumption. This project anticipates evaluating both the thermal and optical properties achieved by the proposed fenestration products, assessing their energy conservation potential, and then transfering the polarized filter technology to the building industry.

GBA Product Innovation Grant Amount: $10,000

Leadership Team: The project team will be led by Professor Dale Clifford in the School of Architecture at Carnegie Mellon University; Professor Volker Hartkopf will also be involved, as will Fulbright Scholar Mario Christiano.

Contact: Dr. Dale Clifford ▪ School of Architecture, Carnegie Mellon University ▪ Pittsburgh, PA
(520) 834-4024 ▪ dalec@cmu.edu ▪ http://www.cmu.edu/architecture/

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