

SmartScreen: Controlling Solar Heat Gain with Shape-Memory Systems

by Peter Yeadon and Martina Decker

Abstract

The interest in smart materials has risen dramatically in recent years, as one can witness by the increase in scientific and architectural publications devoted to their novel properties and behavior. Our team is in the midst of researching how a particular set of smart materials, thermo-responsive shape-memory alloys, can control solar heat gain through glazed building envelopes to conserve energy expended on cooling. We have been pursuing perforated textile membranes that are activated by shape-memory alloys (SMAs) so that -- when a particular temperature is exceeded -- apertures in the membrane can close to block sunlight from warming the interior. Currently no such technology is available, however our research has identified a couple of recently developed SMAs as promising candidates for a new class of material devices that can be engineered to open/close the membrane apertures when solar heat gain is advantageous/disadvantageous, simply by changing their shape when the interior ambient air temperature falls/rises.

We request support for the testing phase of our research, wherein vital information from newly fabricated prototypes will be collected and analyzed at the Rhode Island School of Design, and shared publicly. It is critical that we verify the effectiveness of our "SmartScreen" in controlling solar heat gain, and confirm it's responsiveness to temperature changes in order to optimize the system. Although the SmartScreen is self-sufficient and does not use any power to operate, it is equally important for us to prove that its embodied energy does not exceed the amount of energy conserved in assisting HVAC systems; after all, our aim is to facilitate energy conservation. Buildings consume 40% of our entire energy supply and the Department of Energy has confirmed that our net energy use for space conditioning will increase substantially, due to climate change. Smart, innovative solutions are urgently needed and we are eager to share our research to help architects realize them.