New 'smart' roof reads the thermometer, saves energy in hot and cold climates

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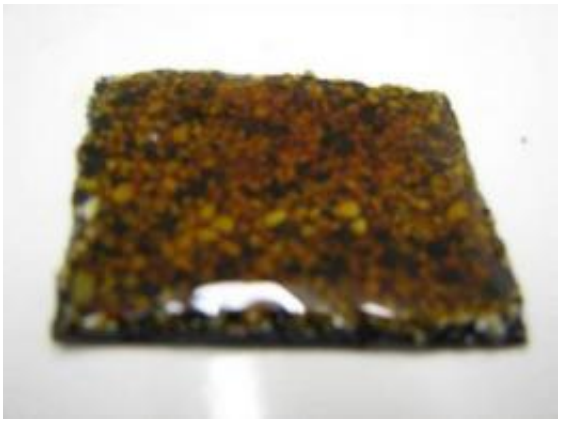


Shingles with a "smart" coating could save energy and lower bills by adjusting to temperature changes. Credit: Ben Wen, Ph.D.

Top a building with a light-colored "cool roof," and it reflects sunlight, cutting air conditioning bills in summer, but increasing winter heating costs. Choose black shingles, and the roof soaks up sunlight to cut winter heating costs but makes the roof bake in the summer sun. One or the other. You can't have it both ways. Until now.

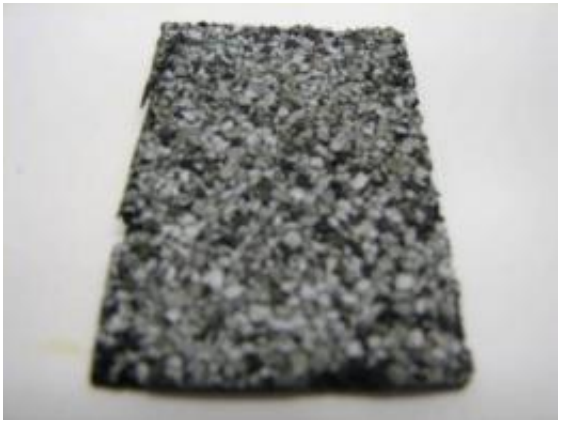
Scientists today reported the development of a "smart" roof coating, made from waste cooking oil from fast food restaurants, that can "read" a thermometer. The coating automatically switches roles, reflecting or transmitting solar heat, when the outdoor temperature crosses a preset point that can be tuned to the local climate.

They described the coating at the 239th National Meeting of the American Chemical Society (ACS), being held here this week.

Roofs coated with the material would reflect scorching summer sunlight and reduce sticker-shock air-conditioning bills. When chilly weather sets in, the coating would change roles and transmit heat to help warm the interior.

"This is one of the most innovative and practical roofing coating materials developed to date," said Ben Wen, Ph.D., leader of the research project. He is the vice-president of United Environment & Energy LLC in Horseheads, N.Y. "This bio-based intelligent roof coating, compared with a traditional cool roof, could reduce both heating and cooling costs as it responds to the external environment. It will help save fuel and electricity and reduce emissions of volatile organic compounds from petroleum-based roofing products. In addition, it will provide a new use for millions of gallons of waste oil after it is used to cook french fries and chicken nuggets."

Scientists already have evidence that "white roofs" — roofs that are painted white to reflect solar heat and help cool buildings during peak summer weather — could significantly reduce global warming by lowering fuel consumption. However, white roofs can have a wintertime heating penalty because they reflect solar heat that would help warm the building. So white roofs are a benefit in summer but a detriment in winter.



This is a conventional roofing shingle. Credit: Ben Wen, Ph.D.

The new "intelligent" coating may sidestep this quandry. Tests on coated asphalt shingles showed that it could reduce roof temperatures by about 50 - 80 percent in warm weather. In cooler weather, the coating could increase roof temperatures up to 80 percent compared with the traditional cool roof. By changing the coating's composition, Wen and colleagues can tune the substance, so that it changes from reflective to transmitive at a specific environmental temperature.

"Even though the roof temperature is reduced or increased by a few degrees, depending on the outside temperature, this change could make a big difference in your energy bill," Wen noted.

In producing the coating, waste cooking oil is processed into a liquid polymer that hardens into a plastic after application. Unlike raw waste oil, which can smell like French fries or fish, the resulting polymer is virtually odorless. Manufacturers could potentially produce it in any shade, ranging from clear to black, depending on what additives are used, he said. The material is also non-flammable and nontoxic.

Wen cautions against pouring ordinary cooking oil on a roof in an

attempt to achieve a similar energy-saving effect. That's because ordinary cooking oil won't turn into a polymer, doesn't contain the key ingredient for controlling infrared light levels, and could well pose a fire hazard for the building.

The coating can be applied to virtually any type of roof. Wen expects that the coating can last many years and can be reapplied when it wears off. If further testing continues to go well, he estimates that the coating could be ready for commercial use in about three years.

Provided by American Chemical Society