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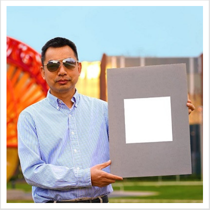
The Whitest Paint Ever Created Is the Opposite of Vantablack, Basically



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Engineers have created the whitest paint ever, an innovation that could help to cool buildings, reduce the energy demands of air conditioning, and mitigate climate change. The new paint reflects 98.1 percent of sunlight, essentially making it the opposite of ultra-dark materials such as Vantablack, which absorbs 99.9 percent of visible light.

The idea of using extremely white paint to lower building temperatures dates back decades, but recent advances in nanotechnology have unleashed new levels of reflectivity—and therefore, coolness. Since 2014, materials scientists have been able to develop coatings that can achieve "daytime subambient radiative cooling," which means that building surfaces are colder in the daytime than the outside ambient temperature.

Now, a team led by Xiulin Ruan, a professor of mechanical engineering at Purdue University, have pushed this radiative cooling to a new limit, according to a study published in ACS Applied Materials & Interfaces. Their ultra-white paint made building surfaces 8°F (4.5°C) cooler than ambient temperatures at noon on a sunny day, and 19°F (10.5°C) cooler than its surroundings at night.

"That's like refrigeration," said Ruan in a call. "It's very hard to get. If you think about the power needed for a 1,000-square-feet of single-storey house, if you paint the roof with our paint, it can give you about 10 kilowatts of clean power" which is "comparable to the cooling power provided by central air conditioners we install for a house like that."

"In other words, on certain days in the summer, you probably don't need to turn on your air conditioner at all," he added. "If the days become extremely hot, you'd need to turn on air conditioning, but our paint will still help offset a large portion of the cooling demand you would need."

Ruan and his colleagues have been developing this paint for years, and have experimented with a wide range of materials and manufacturing techniques. They eventually settled on paint pigmented with barium sulfate, a white powder that is reflective across all wavelengths of sunlight.

This broad reflectivity distinguishes the new paint from most commercially available white paints, which tend to use titanium dioxide as pigment. Though titanium dioxide is reflective in the visible and near-infrared bands of sunlight, it absorbs ultraviolet (UV) light, causing some heating. Barium sulfate, in contrast, reflects UV light, enabling it to stay cooler on hot days, Ruan said.

Another key to the paint's performance is the variable range of particle sizes inside the substance. The average size of the particles in the paint hovers around 400 nanometers, which matches the wavelength of sunlight toward the middle of its spectrum. But the team included particles with sizes that span several hundred nanometers in order to optimize the reflectivity of the paint across the broad spectrum of sunlight.

"If you just do the one particle size, you won't do a great job because sunlight has different colors in it, which means it has different wavelengths in it," Ruan explained. "In order to reflect the entire solar wavelength range, we put in a wider range of particle sizes."

The highly reflective paint is an improvement on an earlier version of the material that Ruan and his colleagues unveiled in an October 2020 study, which reached a reflectivity of 95.5 percent. Naturally, that raises the question of whether the researchers might ever reach an even higher level of reflectivity in future iterations of the paint.

"It's hard to get a lot of improvement because the physical limit will be 100 percent, so we're close to that," noted Ruan. "We have 1.9 percent of room to play with, and I think there should be some promise to look at other materials and the polymer matrix to further push it towards the 100 absolute limit."

The team is also hoping to reduce the width of the required paint coat in future versions of the material. Right now, a layer of paint about 200 microns thick needs to be laid onto surfaces for it to reach its high reflectivity. The researchers would like to slim down that figure to 50 to 100 microns, which would be more efficient for consumers.

"We are working with a large corporation towards commercializing this technology and we're doing further testing, such as long-term reliability, and so on, to make it ready,” Ruan said. “So hopefully, in a year or two, we can start to manufacture these paints and make them available for customers to use.”

Read the original article on VICE.