

MAKING LEAPS TOWARDS SUSTAINABLE AIR CONDITIONING

One of the world's most innovative air conditioning companies has an R&D team of 20,000 working on **NEW TECHNOLOGICAL SOLUTIONS**.

Air conditioning is becoming crucial for our comfort and survival, but it's a significant contributor to climate change, with the technology being responsible for an estimated two billion tonnes of carbon dioxide annually, or nearly 4% of global greenhouse emissions. Researchers at one company in China have been tirelessly working to reduce the climate impact of air conditioning, while improving its performance, through award-winning new designs.

▲ **An illustration of graphene.** Midea researchers have developed an ultra-thin coating containing graphene which enhances the heat exchange efficiency and extends the lifespan of air conditioners.

"Our goal is to provide the best sustainable heating, ventilation and cooling solutions, creating a comfortable and healthy environment, while supporting carbon neutrality and sustainable development goals," says Jinbo Li, dean of Midea's Residential Air Conditioning Innovation Research Institute, in Foshan, Guangdong.

HEAT EXCHANGE

Air conditioning controls temperature by moving heat around. A key component is the exchanger, which transfers heat between mediums. This usually involves refrigerant pipelines and fins that exchange heat between the refrigerant fluid and air.

Metal fins increase the surface area of the heat

exchanger, which enhances the heat transfer process. However, the thin liquid film on the surface of the fins causes corrosion during use, especially on islands or in coastal areas. The greater the sunlight and humidity, the shorter lifespan, the lower heat exchange efficiency, and higher scrap rates of fins.

Although these fins are coated with a layer of anti-corrosive substance to extend their service life, the coating will reduce thermal conductivity efficiency.

Research to solve this has generally looked at limiting corrosion on existing materials, but Xiuling Shang, a material scientist at the institute, thought there was a better way.

Her team has been searching for novel materials, and studying key factors that impact the performance of fins. They collected a large number of used heat exchangers from countries including Australia, Malaysia, and China, and then analysed the failure mechanism of fins and their coatings, identifying key influencing factors such as salt spray, light, temperature and humidity. Then they established models in the laboratory as the foundation for improving fin materials.

From this starting point, Shang wondered: "How can we balance many performances, such as machinability, corrosion resistance and thermal conductivity, to achieve an optimal effect?"

Dr. Microbe/Stock/Getty

One solution to reduce corrosion is to increase the thickness of the coating on fins, but as this reduces the thermal conductivity of the fins, it also causes a reduction in the efficiency in terms of heat transfer.

Shang's team instead has developed an ultra-thin coating containing graphene. This two-dimensional carbon material has a high specific surface area and high thermal conductivity, making it a good candidate for novel anti-corrosive coatings.

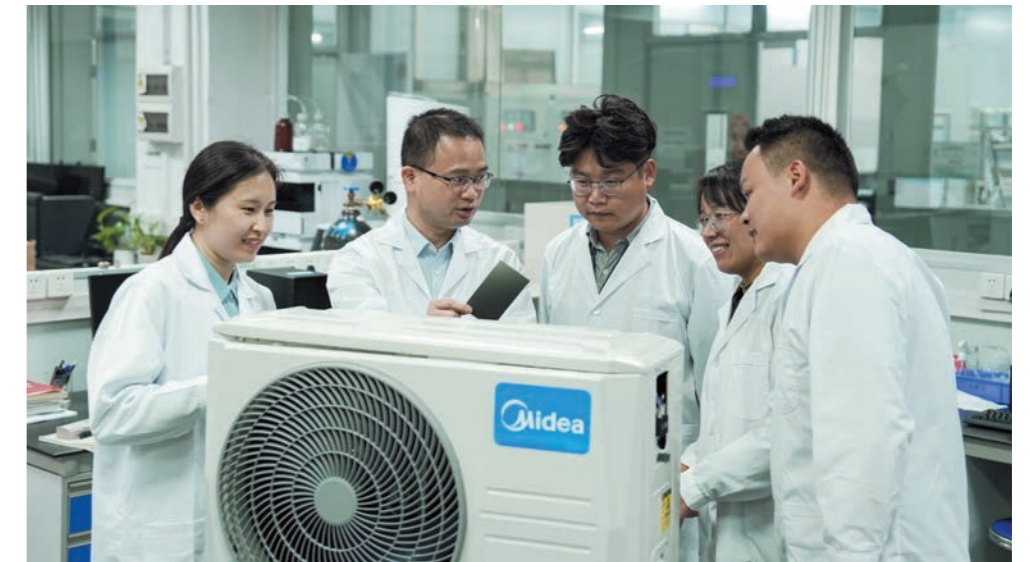
Midea's tests suggest this coating performs well. Shang says the product has resulted in the thickness of anti-corrosive coatings being reduced by up to one third and she hopes that it could reduce corrosion by up to 90%. It also enhances the heat exchange efficiency and significantly extends the lifespan of the air conditioner. The novel coating is already being used in air conditioning systems in China and globally.

ENERGY EFFICIENT

To further reduce environmental impact, Midea has adopted a new more environmentally friendly propane refrigerant. "The switch from the traditional refrigerant, R410A, to R290 significantly reduces equivalent carbon dioxide emissions from 2,000 kilograms to just 0.3 kilograms per kilogram of refrigerant released," says Zhigang Xing, head of Midea's overseas air conditioning research and development.

This achievement earned Midea Air Conditioning the 'Outstanding Contribution to Energy Conservation and Environmental Protection Award' from the United Nations Industrial Development Organization (UNIDO) in 2020.

UNIDO said it "would like to express its highest appreciation to Midea, for their ongoing



▲ Midea's R&D staff are conducting failure mechanism analysis of its heat exchanger coating, looking to improve the performance of the air conditioners it manufactures.

efforts to develop, manufacture and introduce to the market residential air conditioners that meet the highest environmental standards."

Now more than 155 countries and regions around the world have reached a consensus to adopt the Kigali Amendment, accepting that R290 is a valid alternative refrigerant technology route. In 2023, Euromonitor International, a strategic market research group, recognized Midea as the global leader in R290 air conditioner sales.

In search of further opportunities for energy conservation and emission reduction, Midea is exploring new refrigeration technologies, such as radiative cooling materials, that can lower temperature by radiating energy, achieving passive cooling without a refrigerant, says Shang.

The energy efficiency of air conditioning is not only reflected in product design, but also in its use. By leveraging AI and cloud computing, Midea achieves more precise control of air conditioning frequency conversion, realizing rapid cooling and maintaining a stable temperature. "This not

only enhances user comfort, but also halves electricity consumption," says Xing.

Currently, more than 10% of global carbon emissions come from burning fossil fuels for heating. For example, in Europe, nearly 80% of household energy consumption comes from heating. "We hope to change this situation," Xing said. Researchers are exploring the possibility of replacing fossil fuel heating with new air conditioning solutions, such as air heating technology, which has high energy efficiency and can provide better heating output at the same energy consumption unit.

In addition, Midea is conducting in-depth research on whole house energy management. Xing said, "If we transition to solar photovoltaic power generation and combine it with existing air conditioning technology, we can provide an improved solution for households."

COLLABORATION CULTURE

All of these innovations have been driven by a company culture that encourages bold ideas and collaboration

with researchers outside the company, says Li. Midea Group has established 33 R&D centres in 11 countries, forming close technical partnerships with local businesses and institutions.

Founded in 1968, Midea has a workforce of more than 190,000, including 20,000 in the research and development division. Midea Air Conditioning boasts more than 20,000 authorized patents and has been honoured with other awards, including the China Patent Gold Award, one of the most prestigious awards co-organized by the China Intellectual Property Administration and the World Intellectual Property Organization (WIPO).

"We actively engage in discussions with the academic community, hoping to transfer their expertise to industry, innovatively solve problems, and create more energy-efficient and environmentally friendly air conditioning," Li says. ■



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