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Plastic, heal thyself: scientists invent smart polymers

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Scientists on Thursday unveiled a new kind of plastic that can repair itself when exposed to ordinary light.

The miracle material could extend the lifetime and improve the durability of dozens of polymer-based products, ranging from common household items such as bags and storage bins to inner tyres and expensive medical equipment, the researchers said.

A polymer is a large molecule, or macromolecule, made up of identical structural units linked through chemical bonds forged when atoms share electrons.

Tough, rubbery plastics are today found in thousands of consumer goods, but the materials used are highly vulnerable to damage caused by scratches, cuts and punctures.

Landfills are full of plastic objects discarded because they broke, cracked or leaked, sometimes causing safety hazards.

Most approaches to healable polymer-based materials require heating damaged areas and applying patches.

Scientists led by Christoph Weder of Case Western Reserve University in Cleveland, Ohio took another tack, creating a self-healing rubbery material containing metal that absorbs ultraviolet light and converts it into localized heat.

"What we have developed is essentially a new plastic material composed of very small chains that stick together and assemble into much larger chains," said co-author Stuart Rowan, also of Case Western.

"But what we have designed into the molecule is the ability to disassemble on exposure to light. When it disassembles the material flows into the crag and the system gets healed."

The study, published in Nature, shows that using light in this way has advantages over direct heating, such as pinpoint targeting of the damaged area, and repairing objects that are still carrying a stress load.

Smart materials with an in-built ability to repair damage caused by normal wear-and-tear could prove useful in transportation, construction, packaging and many other applications, the researchers said.

"Healable polymers offer an alternative to the damage-and-discard cycle, and represent a first step in the development of polymeric materials that have much greater lifespans than currently available," Nancy Sottos and Jeffrey Moore, researchers at the University of Illinois, said in a companion commentary.

But several hurdles remain before the proof-of-concept study can be translated into industrial-scale production, they said.

Many polymers are plastics, but other natural and synthetic materials also fall into the same category.

Synthetic polymers include artificial rubber, neoprene, nylon, PVC, polystyrene, polyethylene and silicone.