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Self-Healing Materials

Your body has the ability to heal itself. A small cut, scrape, or even a broken bone will immediately activate your body's own healing processes. When you seek professional help for a serious injury, medical assistance is often limited to preventing infection, re-aligning broken bones, and cleaning wounds, so that conditions are right for the body to heal itself.

The 20th-century materials that represent the backbone of our current technological world aren't able to heal themselves. As a result, structures built with these materials have a limited lifespan before corrosion and other environmental defects necessitate repair or replacement.

Material scientists and engineers are now learning how to create self-healing materials that can repair their own structures without human intervention. Recent press releases from university researchers describe the development of a self-healing protective finish and a self-healing structural material.

Paul Braun and Scott White, professors at the Beckman Institute at the University of Illinois, have recently developed a self-healing coating that prevents corrosion by healing breaks in the protective coating's surface. Braun sent me the photos and illustrations shown here to help me explain how the Braun and Scott self-healing finish breakthrough, without human intervention, repairs damages to its protective coating.

Photo 1 shows two steel samples. The one on top was coated with a conventional rust inhibitor and the one on the bottom with their self-healing finish. Both samples were scratched to break their protective coatings.

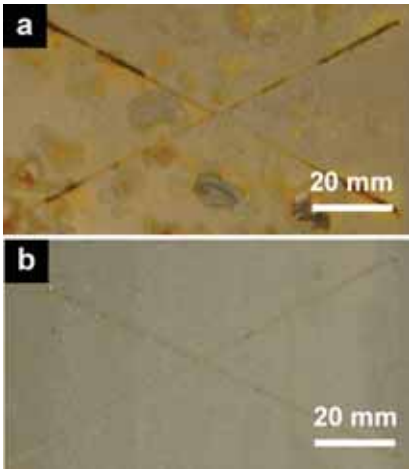


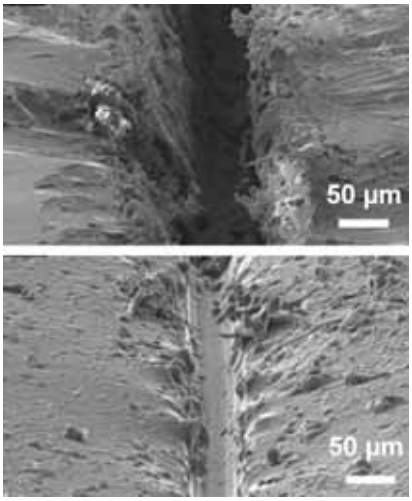
Photo 1

These scratches were made equal in depth and width to guarantee that the only difference in the two samples was their coatings.

The metal samples were then immersed in saltwater. When removed, corrosion was visible on the metal protected with the conventional rust inhibitor. However, the surface of the sample with the self-healing coating didn't show any signs of corrosion.

The scientists used a scanning electron microscope to focus in on the scratched surfaces so that they could see the effectiveness of their self-healing finish. Photo 2 shows what the surfaces looked like at the microscopic level. The top image shows how corrosion has eaten into the conventionally protected metal. The bottom one shows that the original scratches have been filled in with a new coating that continues to protect the metal from corrosion.

The drawings in Fig. 1 show what is going on at a nano scale. Figure 1a shows microcapsules encapsulated within the self-healing finish. When these capsules are broken (Fig. 1b), some microcapsules spill a polymer and others spill a catalyst. When these two ingredients mix (Fig. 1c) they react with each other creating a siloxane polymer caulking that fills in the scratches, thus sealing the scratches (Fig. 1d). I will explore self-healing structural materials in a future column.



Photos courtesy Paul Braun

Photo 2

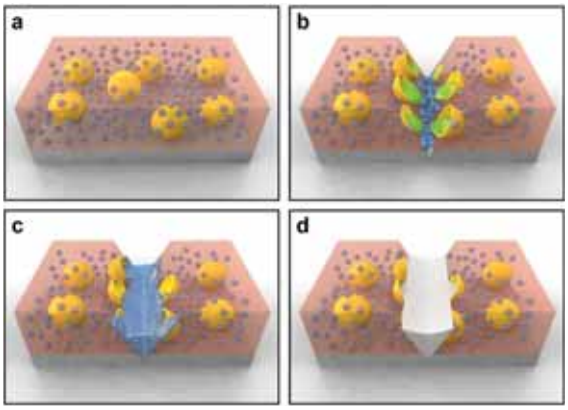


Fig. 1—Visual of how self-healing works

Recalling the Facts

New technology often has positive and unforeseen negative effects.

1. Describe the positive effects of this technology.

2. What effect would this technology have on landfills when the products that contain these finishes are outdated?

Alan Pierce, Ed.D., CSIT, is a technology education consultant. Visit www.technologytoday.us for past columns and teacher resources.