# A new catalyst yields a rubbery plastic

In the movie *The Graduate,* actor Dustin Hoffman received a one-word tip about a future business career: "Plastics." Had Hoffman played a chemist in that movie, the tip might have been "polypropylene."

So common has polypropylene become that one finds this hard plastic all over a typical U.S. home — in cups, bottles, carpeting, clothing, insulation, and appliances. The plastic dominates household use despite an important limitation: rigidity. Though cheap and easy to make, polypropylene often feels stiff and tends to snap under pressure.

To make a more flexible polypropylene — one that yields instead of fracturing when subjected to stress — chemists Geoffrey W. Coates and Robert M. Waymouth of the California Institute of Technology in Pasadena and Stanford University, respectively, have developed an "oscillating" catalyst. This catalyst produces polymer chains with alternating rigid and elastic segments. The resulting plastic feels rubbery, not stiff, they report in the Jan. 13 SCIENCE.

Chemists forge polypropylene from a common oil-derived gas. The plastic forms when individual units, or monomers, link into a polymer chain. The process requires a catalyst whose surface contains templates in which the reactions can occur.

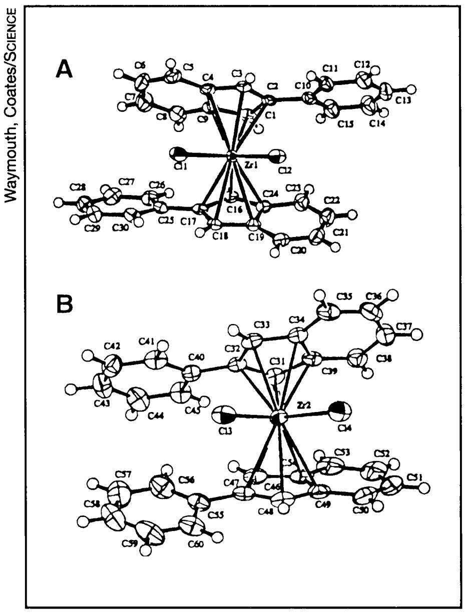
Ordinarily, those templates permit only one type of reaction to take place. The new catalyst, though, contains parts that move freely, allowing it to change shape and making possible more than one type of reaction.

"Picture the catalyst as a large pair of jaws with a zirconium metal atom sitting in the center," says Kenneth B. Wagener, a chemist at the University of Florida in Gainesville. "In a normal catalyst, the jaws would be in a fixed position. But Coates and Waymouth have designed the jaws so that each half can swivel. The template spins while it's producing the polymer, so you end up with alternating segments of plastic and elastic polypropylene. That's why they've called it an oscillating catalyst."

The hard plastic segments give the material strength and stability, while the elastic portions make it tough and flexible, Waymouth explains. By regulating the pressure and temperature of the production process, he and Coates can control the relative lengths of the material's plastic and elastic portions.

Waymouth likens the technique to making pasta with a machine. "For each kind of pasta — spaghetti, linguini, etc. — you have a mold with a certain shape that you press the dough through," he says. "Suppose you could change the shape of the mold while you're pressing the dough. You'd get segments of spaghetti, linguini, spaghetti, linguini, connected together in a chain. Our process for making elastic polypropylene works sort of like that." — *R. Lipkin*

Waymouth, Coates/SCIENCE




*Oscillating catalyst pivots, yielding two templates (A) and (B).*

# Lead may foster immune attack on brain

High exposures to lead, a toxic heavy metal, have been linked to a range of neurological problems, including reduced IQ, impaired hearing, and trouble maintaining motor control and balance. Science has yet to tease out what lead does to the brain to yield such effects, but it now appears that this metal may eventually enlist the body's immune system in its attacks.

Because the immune system doesn't tend to operate in the brain and brain proteins don't ordinarily enter the blood or the rest of the body, the system's sentry molecules will treat any brain protein they encounter as a foreign invader — and develop antibodies to it. These antibodies, therefore, indirectly signal the existence of brain damage.

Over the past 2 years, Hassan A.N. El-Fawal at New York University's Institute of Environmental Medicine in Tuxedo, N.Y., has correlated brain proteins circulating in the blood of lead-exposed rodents with bloodborne antibodies to them. If he and his colleagues could link lead exposure to these antibodies, they would have a simple blood test to pick up even early effects of this metal on the brain — changes that predate overt symptoms and irreversible damage.

They're not there yet. However, their studies have uncovered evidence not only that lead toxicity leaves a telltale trail of brain proteins in the blood, but also that lead enhances the responsiveness of the immune system in attacking those proteins.

Working with El-Fawal and Carroll A. Snyder, Stacey J. Waterman recently inoculated healthy mice with three doses of either of two brain proteins; the doses were delivered 2 weeks apart. Some animals received normal, healthy forms of the proteins, while others got versions that had been incubated for 24 hours with lead.

In the December ENVIRONMENTAL HEALTH PERSPECTIVES, these NYU researchers now report that when assayed 10 days after the last dose, all mice showed some antibodies to the brain proteins in their blood. But those that had received lead-incubated proteins exhibited significantly more. These data show that "lead enhances the immunogenicity of two nervous system proteins," the team concludes, and supports the hypothesis that lead's neurotoxicity traces to "production of autoantibodies against neural proteins."

In a related, unpublished study, El-Fawal correlates the concentration of these antibodies in the blood of Egyptian battery workers to their lead exposure — and to the severity of their neurological symptoms.

Though preliminary, the NYU group's research "is very suggestive" that antibodies to brain proteins might be "setting up an immunological attack on the brain," notes David A. Lawrence of New York State's Wadsworth Center in Albany. His own work indicates that exposure to lead and various other heavy metals can upset the balance between two classes of the immune system's helper T cells in favor of cells less able to ward off certain viral infections.

While promising, El-Fawal's goal of establishing neuroantibodies as markers of lead's neurotoxicity won't prove easy, observes neuroscientist James O'Callaghan, who is working at Rockefeller University in New York City.

Indeed, adds George Leikauf of the University of Cincinnati, while the doubling and tripling of antibody concentrations observed after exposure to lead-incubated proteins "are statistically significant, physiologically they're not." However, El-Fawal counters, neuroantibody amounts he's seen in lead-exposed workers are typically 1,000 times greater than those in nonexposed individuals. — *J. Raloff*