Tin replaces lead in automobile steel

Car engines already run on unleaded gasoline. Now, researchers have found a way to get the lead out of the engine itself. Scientists at the University of Pittsburgh have created a leadfree steel that can be used in automobile engines and transmissions. Not only is the new alloy environmentally friendly, it also may cost less and be easier to recycle than the traditional metal.

The type of steel commonly used for machined car parts contains a low concentration of lead, about 0.15 to 0.33 percent by weight. Lead makes the material, known as 12L14, easy to drill and cut, but its presence also requires that steelmakers follow strict safety measures to ensure that lead fumes and dust don't endanger workers or pollute the environment.

Anthony J. DeArdo and C. Isaac Garcia found that tin can replace the lead in 12L14 without changing the steel's mechanical properties. They expect a patent for the material in the next few weeks.

DeArdo and Garcia began looking for alternatives to leaded steel 5 years ago, when steelmakers became concerned that the government might ban lead as an ingredient. "Since 12L14 is the workhorse for machining applications, there was not a suitable candidate to replace this material," says Garcia.

Although lead has been in steel for many years, there was no scientific agreement on how it makes the metal easier to machine, Garcia says. Using a field-ion microscope that could identify the positions of individual lead atoms in the alloy, he and DeArdo determined the mechanism. They learned that lead atoms collect at the edges of metal grains, making it easier for the grains to slide past each other and separate.

Machining a part essentially fractures the material, says Garcia. Carving steel parts, for example, "produces small chips, like sharpening a pencil."

The researchers then looked for other, nontoxic elements that could also collect at these grain boundaries and produce a machinable steel. Tin at a concentration of 0.035 to 0.08 percent by weight—significantly less than the amount of lead it replaces—worked best out of all the alternatives they tried.

The Curtis Screw Co. in Buffalo, N.Y., has cut about 15,000 pounds of the leadfree steel into precision parts, says president Bob Squier. "It machines at least as well as 12L14. That's encouraging," he reports. Tests at the University of Pittsburgh had indicated that tools can machine the new steel much more easily than they can 12L14, Squier says, but so far, tests in his factory haven't borne that out.

The steel should cost less to produce, Garcia says, since steelmakers won't have to collect lead fumes emanating from molten metal. Chips and scraps cut from traditional steel parts also contain lead and must be handled in a special way, but the new material can be melted down without such precautions. "Leaded scrap is very difficult to get rid of," says Squier. "It's not environmentally friendly."


Joe Kapelewski/Univ. of Pitt., CIDDE

Automobile parts made by the Curtis Screw Co. using a new, leadfree steel.

Lead is not a big concern in recycling old cars because the small amount of lead in them becomes diluted in the overall mix of scrap metal, says Greg Crawford of the Steel Recycling Institute in Pittsburgh.

Curtis Screw already has a production order from the Ford Motor Co. for parts made out of the new alloy, says Squier. Whether the steel catches on will depend on automaker demand, but "we're pretty excited about it," he says. —*C. Wu*

Testosterone keeps male brain in shape

Men are from Mars, and women are from Venus—so claims a best-selling book on male and female behavior. On a more scientific level, neuroscientists indeed have evidence that various brain regions differ in size or activity between men and women. When and why do these gender-based neurological differences arise?

Until recently, scientists pointed to embryonic development, or puberty at the latest, as the period when male and female brains diverge structurally and settle into their final forms. Challenging that view, a new study finds that the presence or absence of androgens—testosterone and related hormones—continues to shape a region of the rat brain well into the animal's adult life.

When adult male rats are castrated, this area of the brain, the medial amygdala, dramatically shrinks in volume. Within a month, it reaches the size seen in a female rat brain, Bradley M. Cooke of the University of California, Berkeley and his colleagues report in the June 22 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. Conversely, in adult females given testosterone, the medial amygdala balloons to male size within several weeks.

"We were a little surprised to see that the sexual dimorphism could be completely explained by adult circulating androgens," says study coauthor S. Marc Breedlove, also of Berkeley.

The medial amygdala in male rats averages 1.65 times the area's size in female rats, a disparity probably explained by its role in sexual arousal. Nerves from the olfactory system run into the medial amygdala, and male rodents seem to use the region to process information about pheromones and other odor-related cues to reproduction. For example, male rats with damage to the medial amygdala don't become aroused by the scent of a female rat.

Other investigators have demonstrated that altering the amount of androgens in the blood changes the size of certain brain regions. The new study, however, is the first to show in mammals that such manipulation can completely reverse a gender-based structural difference in an adult brain. The medial amygdala's changing volume appears to stem from the nerve cells there swelling or shrinking rather than from the creation of new cells or the death of existing cells, says Breedlove.

The study's findings add to a growing belief that the form and function of the adult brain are not rigidly set. "For a long while, people simply considered structural changes in the adult brain to be impossible," notes Bruce S. McEwen of the Rockefeller University in New York.

McEwen suspects that circulating androgens do more than regulate the size of the medial amygdala. They may also influence the brain region's function by altering the inner workings of nerve cells.

Breedlove agrees, "I wouldn't at all be surprised if there were many other changes that we didn't measure."

One lesson that scientists should draw from this study, he adds, is that the structure of the brain is not set permanently at birth. Consequently, scientists must not regard any differences found between male and female brains, or even between those of heterosexuals and homosexuals, as becoming fixed early in development, says Breedlove.

The study also adds to the list of possible risks faced by athletes and other people using androgen supplements, an issue that gained prominence last year when baseball player Mark McGwire acknowledged taking the testosterone precursor androstenedione. "Steroid hormones aren't just affecting the body. They're also affecting the brain," says Breedlove. —*J. Travis*