Materials Science

Metals by microalloying

One of the most pressing needs in materials research has been to find a way of making new kinds of structural materials that can withstand high temperatures. Now a team of University of Connecticut metallurgists, working under an NSF grant, has discovered a technique to produce metals with high-temperature deformation reduced by more than a factor of three. The technique, called microalloying, will lead to a "future generation of advanced high-temperature materials," they say.

Microalloying consists of mixing tiny amounts—as low as 20 parts per million—of trace elements to otherwise highly purified metals. The effect was discovered accidentally during studies of unintentional impurities in metals used for such high-temperature applications as blades in jet engines. If temperature-induced deformations, collectively called "creep," can be reduced, a considerable reduction in fuel consumption in jet engines, for example, could be expected. The new materials might also find application in such diverse areas as thermonuclear reactors and electric power plant turbines.

Apparently microalloying works because the trace elements cluster about naturally occurring defects in the base metal, "pinning" the defects so they cannot move about and cause deformation.

Tailoring hard materials

A new material that can be tailormade to hardnesses exceeding all other materials except diamonds has been developed by a UCLA engineering professor, Rointan F. Bunshah, in a process 100 to 1,000 times cheaper than making various grades of synthetic diamonds.

The material is titanium carbide which is deposited in thin layers on the surface of metallic substrates. An electron beam is used to vaporize titanium metal in a radioactive, hydrocarbon atmosphere, forming the new compound, which then condenses on metallic surfaces at the desired rate and hardness.

The new material will have immediate uses, Bunshah says, including cutting tools, turbine blades, textile machines and possibly catalysts for the pollution devices of automobiles. Millions of dollars should be saved each year, he predicts, because of increased drill bit effectiveness alone. Bunshah is currently trying to create other versatile, superhard synthetic materials, using his technique.

"Slipperier than an angry eel..."

Like so many simple ideas, one has to wonder why no body thought of it earlier: The problem was to make grease more slippery, and General Motors engineers have just announced an appealingly simple solution—put tiny ball bearings in it. By mixing tiny spheres of steel with heavy grease, they told the annual meeting of the American Society of Mechanical Engineers, the coefficient of friction can be reduced by a factor of 100. In low-speed applications, the new stuff, called "ball-grease bearing" works almost as well as a roller bearings at a fraction of the cost, with less deflection under load.

Ball-grease bearings promises to replace ordinary grease and bearings in many applications, especially those involving heavy loads in slow, reciprocal motion. Placed on the new grease, a 1,000-pound load can be moved with one pound of force.

Environment

Bad food to make good coyotes

The war on coyotes by stockmen to control sheep losses is an indiscriminate and oftentimes cruel one. The principal methods employed—bounty hunters, traps and lethal poisons—do not distinguish between sheep killers and other coyotes and animals. Three psychologists from the University of California report in the May 3 SCIENCE a method of coyote control that could save both the prey and predator.

John Garcia, Walter G. Hankins and Kenneth W. Rusiniah have been able to develop in seven coyotes conditioned aversions to lamb and rabbit meat by producing lithium chloride illnesses in them. They found that one trial with a meat laced with lithium chloride is sufficient to prevent the coyotes from eating the flesh of that prey, though not always from attacking it. Two treatments suppressed attack of the particular prey and left the coyotes free to attack an alternative one.

"We propose a two-phase conditioning process in mammals," say the researchers. "In phase one, the flavor of food becomes aversive after one illness, after which the sights and sounds of the prey may still elicit attack. . . . Phase two occurs when the auditory, visual and olfactory cues from the prey become associated with the aversive flavor, thus subsequent attacks are inhibited and perhaps a second treatment is unnecessary. . . . In addition, the feeding habits of the mother coyote averted to sheep might be transmitted to her pups, via flavor which her diet imparts to her milk, and by their early experience with prey she brings to the den. Similar mechanisms have been demonstrated in the rat."

Recycling chicken wastes

Poultry waste can be recycled and fed back to the chickens on an economical basis in large-scale poultry operations, concludes a study prepared by the U.S. Department of Agriculture's Economic Research Service (ERS). It examined the economic aspects of drying and recycling the wastes from poultry, both layers and broilers, and feeding them to livestock and chicken. The wastes can be processed and fed back on at least a break-even operation in 50,000-to-80,000 size layer operations. Trials indicate that up to 12.5 percent of dried waste in the chickens' feed ration does not adversely affect egg production and feed efficiency, though at higher percentages both body and egg weight are affected.

The dried wastes can also be fed to dairy and beef cattle. Beef cattle rations can contain up to 30 percent dried chicken wastes before adverse effects on performance and carcass quality are significant. The major problem with feeding the wastes to beef cattle was found to be its palatability to the animals.

Wildlife vs. the U.S. Army

Wildlife and the U.S. Army are in competition for land in Colorado, according to the Wildlife Management Institute. A proposed Pueblo Resevoir wildlife management area, located on the Arkansas River west of Pueblo, is threatened with expansion plans by the Army at Fort Carson. It wishes to acquire the 10,570 acres of land and water as part of an 80,000-acre acquisition on which to conduct war games. The Army's request for funds to acquire the land is in the Administration's budget, now before Congress. Local residents are opposed to the Army's move as the Army's use of tracked vehicles in the area would destroy important wildlife habitat and hinder public access.