Chemistry

Hot-spot bubbles ease glassmaking

Metallic glasses may blast off now that sonochemistry promises an easy way to make them. Also called amorphous metals, these glasses possess unusual electronic and magnetic properties but are tough to make because the molten metal must cool very quickly to prevent crystallization, says chemist Kenneth S. Suslick of the University of Illinois at Urbana-Champaign.

But Suslick and his colleagues have now made amorphous iron using ultrasound. High-intensity pulses of sound cause bubbles to form, expand and then implode, creating short-lived hot spots that reach temperatures of about 5,200 kelvins, says Suslick. Their rapid cooling helps create metallic glasses.

By zapping solutions of powdered iron pentacarbonyl for three hours with ultrasound, the researchers made amorphous iron that assayed 96 percent pure by weight, they report in the Oct. 3 NATURE. Other methods yield no better than 80 percent.

The scientists also note that this amorphous iron worked better than crystalline iron powder as a catalytic agent in converting carbon monoxide and hydrogen to hydrocarbons. They suggest the larger surface area of the amorphous form enhances the chemical reactivity.

A change of (crystal) face slows scale

Davey et al /ICI

Phosphonate compounds cause rhombic barium sulfate crystals (top) to develop curved sides (bottom).

Biological molecules function by having folds, kinks and charged regions that "recognize" specific substances and act as docking sites. When a substance docks, this alters biologic activity. To deactivate biological molecules, pharmacologists trick them with synthetic chemicals designed to fit into these sites and block the normal attachment by a natural substance.

That principle, molecular recognition, also applies to inorganic materials, chemist Roger J. Davey and his colleagues at ICI Chemicals and Polymers Limited, Runcorn, England, demonstrate in the Oct. 10 NATURE. Learning about molecular recognition can aid the design of anti-scalants to prevent the buildup of barium sulfate, whose crystals cause problems inside water pipes, they note.

Crystals grow into characteristic shapes by adding material at particular growth sites. Barium sulfate crystallizes in the form of rhombic plates. But after adding different chemicals to solutions of barium sulfate, the ICI team discovered that a compound with two phosphonate groups linked by a chain of three atoms caused the rhombic plates to develop pinched corners. When the scientists increased the phosphonate's concentrations, disks, not rhombic plates, developed.

They concluded that the two phosphonate groups "looked like" the bottom of a sulfate to the crystal surface. But when the ions due to form the next layer reach the growth site with the phosphorous compound attached, "they feel the presence of the phosphonate," says Davey. As a result, the crystal stops growing and deposition ceases.

"What is new is the understanding we've put into the design of these phosphonates," notes Davey. Now chemists know very specifically what arrangement of atoms works best to prevent barium-sulfate buildup, he adds.

Science & Society

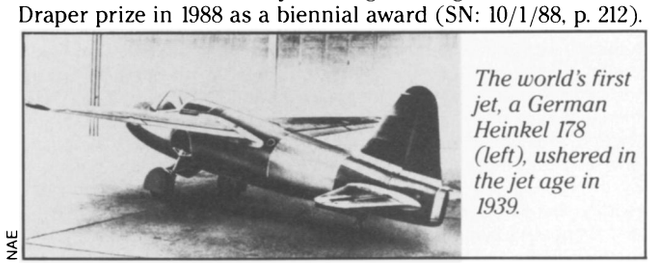
Turbojet's inventors earn Draper Prize

The fathers of the jet age will share the 1991 Charles Stark Draper Prize, the world's largest cash award for engineering achievements, the National Academy of Engineering announced this month in Washington, D.C.

The winners, German-born Hans J.P. von Ohain, 79 – now a senior research engineer at the University of Dayton (Ohio) Research Institute – and Sir Frank Whittle, 84 – a British aviator who now serves as an adjunct research professor at the U.S. Naval Academy in Annapolis, Md. – built the world's first turbojets on the eve of World War II, working with no knowledge of each other's activity until years later. They will each receive a gold medal and will share $375,000.

Both inventors marvel at the strides made since their first test flights 50 years ago. Their turbojets generated about 1,000 pounds of thrust while modern jet engines produce 60,000 pounds and work much more reliably. "I thought I was lucky when I could get it to run a half an hour without a breakdown," says Whittle about his first engine.

The National Academy of Engineering established the Draper prize in 1988 as a biennial award (SN: 10/1/88, p. 212).



NAE

The world's first jet, a German Heinkel 178 (left), ushered in the jet age in 1939.

Lead: New levels of concern

The Centers for Disease Control (CDC) has lowered its "threshold of concern" for blood lead levels, citing mounting evidence that levels previously believed safe can cause developmental disorders in children.

In 1985, CDC revised its definition of lead poisoning from 30 to 25 micrograms of lead per deciliter (μg/dl) of whole blood. Last week, the federal agency announced an expanded definition that specifies several "levels of concern" and recommends actions for each level. For instance, it now advises government agencies to launch lead-awareness campaigns in communities where many children have blood lead levels of 10 μg/dl or higher. And when blood lead reaches 20, CDC recommends medical evaluation and removal of the lead source.

In 1986, an internal EPA staff report proposed lowering the threshold of concern because studies indicated that even lead levels below 20 μg/dl could cause women to deliver low birthweight babies, and result in IQ deficits and slow neuromotor development in children (SN: 9/13/86, p.164; 11/22/86, p.333). Other recent research has suggested that such levels can impair children's hearing and raise blood pressure in adults (SN: 12/20&27/86, p.390; 9/3/88, p.158).

CDC urges blood lead screening for children under age 6, one-fifth of whom have levels exceeding 10 μg/dl, it estimates.

Fragile Antarctica gets some protection

Nearly all countries with bases and research stations in Antarctica agreed this month to add the first comprehensive environmental provision to the 1959 Antarctic Treaty. The new protocol bans mining and oil exploration, regulates waste disposal, conserves marine resources, and protects native plants and animals on the icy continent for the next 50 years.

Of the 26 treaty members, 24 have signed the agreement. Japan and South Korea are expected to sign within a year, says Edwin Brown of the State Department's Division of Polar Affairs.