Ivars Peterson reports from St. Louis at the meeting of the American Chemical Society

Building up to element 108

Proton by proton and neutron by neutron, scientists are building new chemical elements that extend the periodic table to larger and larger atomic numbers. The latest addition is element 108. In an experiment that involved bombarding the isotope lead-208 with iron-58 atoms, a team of West German researchers last month created three atoms of an element with 108 protons and 157 neutrons in its nucleus. Although the atoms had lifetimes only milliseconds long, the researchers were able to track the radioactive decay of these atoms to confirm the discovery.

Darleane Hoffman of the Los Alamos National Laboratory in New Mexico says there is little doubt about the creation of element 108 because the decay process is so well characterized. However, some doubt still surrounds the synthesis of element 109, tentatively announced two years ago by the same Darmstadt-based German group. The researchers managed to get only one atom of the element, and no other group has confirmed the result. In the case of element 108, the surprise is that its lifetime is three orders of magnitude longer than theoretically predicted, says Hoffman. This leaves open the possibility of creating elements with even higher atomic numbers since the atoms may not decay too rapidly to be detected.

A chemical concert sound

Music composed a century ago by a chemist and played on instruments crafted during the past year by another chemist highlighted a special concert at the Kiel Opera House in St. Louis. Russian chemist Aleksandr P. Borodin contributed the music, while Joseph Nagyvary, a biochemist at Texas A&M University and an amateur violin maker, provided the two violins, viola and cello. The concert also tested Nagyvary's success in duplicating the sound quality of famed 300-year-old stringed instruments built by craftsmen like Antonio Stradivari.

Nagyvary's approach to violin making involved delving into the past to rediscover the techniques used by the best 17th-century violin makers. He found that the secret lay in the way these craftsmen chemically treated the wood they used for carving violins. These treatments, involving many steps and substances like potassium tartrate dissolved in beer or wine, preserved and strengthened the wood by leaching certain substances out and adding others to it. This care and skill resulted in musical instruments highly valued by serious musicians today. Nagyvary used his findings to develop chemical treatments and varnishes that he felt would achieve similar high quality results.

Last week's concert featured the first performance by a full string quartet of Nagyvary instruments. Members of the Landolfi String Quartet of St. Louis played half of the concert with their own instruments and half with the Nagyvary instruments. Although the test could hardly be called a scientific experiment, the judges had high praise for the Nagyvary instruments. Several preferred the sound of the new violins. One of the musicians later commented that Nagyvary's work presented the "thrilling prospect" of making first-rate concert violins available to many more musicians. Stradivari himself made only about 1,500 instruments, and fewer than 200 are still in excellent playing condition.

Recipes with a pinch of polysilane

A pinch of polysilane may be just the ingredient to simplify the making of many widely used polymers such as polystyrene and polymethyl methacrylate. Polysilane, itself a polymer, has a chain of silicon atoms as a backbone. Many different types of polysilanes with widely varying properties can be synthesized because various organic groups can be attached to the silicon atoms. The key property that makes a polysilane useful as a kind of catalyst, says chemist Robert C. West of the University of Wisconsin in Madison, is its extreme sensitivity to ultraviolet light.

Polysilane molecules play the role of "photoinitiators" in the making of polymers. Ultraviolet light breaks polysilane molecules into fragments called radicals. These highly reactive pieces, which carry unpaired electrons, attack, for example, double bonds in other organic compounds that are used as starting materials for making polymers. This creates new radicals, and step by step, these pieces add together to form long polymer chains. Polysilane is not a true catalyst because silicon atoms from it also end up incorporated in the polymer molecules.

The advantage of using a polysilane, says West, is that compared with photoinitiators now in use, much smaller amounts of the substance are required for the reaction to be completed. Polysilanes absorb ultraviolet light very efficiently, and a single photon of light energy yields three radicals, including one called silylene, which has two unpaired electrons. Because polysilanes are so active and only minute quantities are needed, the resulting products are more pure than those made using conventional photoinitiators. Suitably modified polysilanes, unlike other photoinitiators, also work effectively in the presence of oxygen. This eliminates the need for expensive inert-gas seals to protect the materials during processing.

West expects that tinkering with the arrangement and type of side chains along the silicon backbone will allow polysilane molecules to be tailored for building specific polymers. The molecule can also be designed to break apart only when exposed to light of a specific wavelength.

Plastic-crystal fibers for insulation

Clothing that protects a wearer against an icy blast of Arctic air or the intense heat of a steel mill may eventually result from current research on chemically treating textile fibers to increase their ability to store and release heat. At the U.S. Department of Agriculture laboratory in Knoxville, Tenn., Tyrone L. Vigo and his colleagues are applying ideas developed originally for solar-energy applications to the creation of "temperature-adaptable" fibers. Their recent work involves filling hollow rayon or polypropylene fibers with substances called plastic crystals, which undergo a transition from one solid form to another at temperatures well below their melting points.

The researchers found that two plastic-crystal compounds in particular were effective in increasing by as much as four times the amount of heat absorbed or released by treated fibers over a given temperature range. In a hot environment, heat would go mainly into changing the form of the plastic crystal rather than into heating the body. During cooling, the plastic crystals, as they return to their original form, would release heat to keep the body warm. The earliest applications for such fibers, says Vigo, are likely to be for insulation and for shelters to protect plants and animals from abrupt, extreme temperature fluctuations.

Dressing for detoxifying success

Wearing protective clothing made from fabrics that incorporate activated carbon may be an effective means for filtering air and removing toxic vapors, say researchers from the American Cyanamid Co. in Stamford, Conn. Their fabric-making technique, similar to a wet papermaking process, produces a feltlike material packed with activated carbon. The chemists use special acrylic fibers that shred readily to form a thick mat that traps a mixture of carbon fibers and granules. Cyanamid's Robert D. Giglia says the resulting material contains as much as 95 percent activated carbon. Although activated carbon itself is already widely used for filtering and purifying liquids and gases, Giglia says the new fabric may be useful for making disposable protective clothing, gas masks and military uniforms.