Materials get a lift from sound

"Acoustic levitation" sounds more like a term you'd hear in a musical magic act than one that applies to making better glasses and other materials. But the decades-old idea of lifting and holding an object in place with intense sound waves traveling in a gas is becoming a technological reality for materials scientists. Their aim is to melt, mix, shape and cool new materials without having them touch the walls of a container, which may react chemically with a sample, introduce impurities or start unwanted crystal growth. At the recent Miami meeting of the Acoustical Society of America, researchers reported on progress with such containerless processing on earth and in space, where the absence of gravity requires less intense sound waves for levitation.

One group, led by Charles A. Rey of Intersonics, Inc., in Northbrook, Ill., is among the first to demonstrate that acoustic levitation at high temperatures is possible in a nearly weightless environment. In an experiment aboard the space shuttle Challenger, during its last successful flight two years ago, samples were levitated and heated to 1,900 kelvins. This is difficult to achieve on the ground because as the temperature rises, the density of the surrounding gas falls and it becomes harder to sustain and focus the high-intensity sound waves necessary to counteract gravity.

The experiments also demonstrated "that glass can be formed more readily without a container in zero gravity than it would be with a container," says Rey. With no container to induce crystal growth, scientists will be able to make amorphous glasses out of a wide variety of compounds and carefully control their properties. Researchers estimate that 10 times as many glassy materials could be made in space as have been made so far on earth. The payoff, says Rey, may be improved fiber optics materials with more uniform optical properties, new types of glasses for lasers and improved glass lenses. With tighter control of glass compositions, some scientists expect, for example, that a typical camera zoom lens — which now uses more than 10 separate layers of glasses to produce the desired index of refraction and dispersion properties — might be made with only half as many layers.

Another space-based application might be the production of perfectly symmetric and uniform glass shells that would be used to hold fuel in inertial confinement fusion, a process being developed for energy and weapons research. According to Rey, no one has been able to make decent commercial-sized glass pellets on earth because with gravity, it's hard to keep a bubble smack in the center of a melted glass sphere. In the shuttle experiments his group nearly showed that the creation of perfect shells is possible, but because the temperature was too high the bubble migrated and escaped before the sphere cooled. The failure to make a shell, however, inadvertently yielded a positive answer to another troubling question: whether it is possible to get rid of glass bubbles in zero gravity.

Tech shorts

• With increasing public awareness of the dangers of exposure to secondhand tobacco smoke, Assay Technology, Inc., of Palo Alto, Calif., is producing a disposable badge that it says is the first low-cost (at less than $5 per badge) and easy-to-use test for measuring smoke and evaluating the effectiveness of smoking policies aimed at protecting nonsmokers.

• Melanin, the pigment found in skin and eyes, is known to absorb different wavelengths of light in proportion to the amount of photochemical damage they inflict on the retina. This makes the polymer a natural for sunglasses, according to James Gallas, a biological physicist at the University of Texas at San Antonio, who has recently patented his process for incorporating synthesized melanin into plastic lenses.

Winning a race in the sun

Belying its squashed-bug profile, the solar-powered vehicle Sunraycer, designed and built by Detroit-based GM Hughes Electronics, sped to victory in a 1,950-mile race across the middle of Australia. Dubbed the "Flying Cockroach" by Australian journalists, the car covered the distance in 44 hours and 54 minutes, traveling at an average speed of 41 miles per hour. Including overnight stopovers, the entire trip from Darwin to Adelaide along a desolate two-lane highway took five and a half days.

Sunraycer finished more than two days in front of its nearest competitor, an entry from the Ford Motor Co. of Australia. A Swiss car, Spirit of Biel, came in third. Billed as the world's first international transcontinental road race for solar-powered vehicles, the competition attracted 25 entries from seven countries. Even two weeks after the race's start on Nov. 1, a few of the vehicles were still on the road gamely trying to reach Adelaide.

Sunraycer's success depended on several new technologies (SN: 10/3/87, p.219). Its specially designed, streamlined body had an extremely low air resistance, or drag coefficient, allowing the car to slip smoothly through troublesome crosswinds. The vehicle carried an array of particularly efficient solar cells similar to those used to power communications satellites and a superior, lightweight electric motor that weighed only 8.1 pounds but could deliver 2 horsepower. A battery of rechargeable silver-zinc cells provided additional power for accelerating and climbing hills.

"We had no mechanical or electronic failures of any kind," says Bruce McCristal of GM Hughes Electronics. "Our only trouble was three flat tires." While some observers estimate that GM spent several million dollars on Sunraycer, the company, saying that the project was part of its general research and development effort, has declined to name a figure. "We learned a lot about low-speed aerodynamics, lightweight structures and materials, and other factors," says McCristal. "This could have practical application in all-electric vehicles somewhere down the road."

The end of a long patent fight

Except in occasional footnotes, the name Gordon Gould doesn't figure prominently in the history of the development of lasers. Nevertheless, the final resolution of a lengthy battle over a laser patent may force a rewriting of some of this early history. Earlier this month, Gould finally received a patent for inventing the gas-discharge laser. He had originally applied for the patent in 1959. The patent, which runs until 2004, allows Gould to collect royalties on all helium-neon and carbon dioxide lasers now manufactured, a market worth hundreds of millions of dollars annually (SN: 2/22/86, p.123).

Gould says he first wrote down his ideas for the laser during "two days of thinking" when he was a graduate student at Columbia University in 1957. However, Gould's delay in applying for a patent allowed physicist Charles Townes, also at Columbia, to file a patent application for the "optical maser," Townes's term for the laser. Townes had invented the maser (short for microwave amplification by stimulated emission of radiation) several years earlier. Townes came to be regarded as "the father of the laser" and in 1964 won a Nobel Prize for fundamental theoretical work that made the laser possible. Gould's work, in fact, built on Townes's research. The long-unresolved question was how novel Gould's own ideas were.

Gould, retired and living in Kinsale, Va., also recently won a 10-year court battle to uphold his patent for an optically pumped laser amplifier (SN: 3/20/82, p.199). He now holds two key patents that cover as many as 80 percent of all lasers manufactured in the United States.