Breaking Through to CLEANER AIR

By James Schultz

In an ideal world, automobiles would eliminate air pollution, not cause it. Emissions from backyard grills, lawn mowers and wood-burning fireplaces wouldn't soil the atmosphere. Nor would acid-rain-causing, wind-carried contaminants from industrial plants trouble plant and animal life.

Kenneth Brown, professor and chair of Old Dominion's Department of Chemistry and Biochemistry isn't about to remove imperfection from the human experience. But a combination gas-recycling/purifying device that he's had a hand in inventing may offer more than incremental improvement. If current attempts to commercialize the technology succeed, it could prove a breakthrough in the field of pollution control, cleaning air more effectively than is currently possible and perhaps even curtailing the often acrimonious debate between environmental activists and industrial interests.

Brown and his collaborators have created a catalytic converter that, at ambient temperature and without moving parts or electricity, is capable of removing from gases lung-damaging toxins like formaldehyde, hydrocarbons and carbon monoxide. In its current, most marketable form, the catalyst — the length and thickness of a small, handleless coffee mug — is used in carbon-dioxide-dependent lasers to recycle and preserve that gas so the lasers can continue to operate efficiently. Ultimately, however, the converter could be adapted for use as a carbon monoxide detector in the home, as a purifying component in firefighters' masks and as an add-on application in a variety of situations where air fouling occurs.

"We're probably one of the few groups in the country to know how to make these catalysts work," Brown says. "We've developed a fundamental understanding ... What we've learned can be applied to other materials in other processes. It's really coming along nicely."

A Secret Sauce

The converter was originally developed to extend the life span of a proposed space-borne, atmosphere-monitoring NASA laser. A key requirement was to keep the sealed laser operational for five years while in orbit, since maintenance would be impossible. The NASA laser has yet to launch; but its designers were finally able to settle on a relatively simple device that would enable the laser to repeatedly recycle and reintegrate the gaseous components necessary to produce concentrated light energy.

In order to break apart or recombine gases, the catalyst relies on unique surface chemistry and a formulation that includes platinum and tin oxide incorporated within a commercially available, honeycombed ceramic form. Brown, who continues to work as a consultant on the project, attributes the converter's efficacy to additional, proprietary modifications. "We're always testing, trying different formulations for different situations," he says. "It's our secret sauce."

The catalyst was developed through the combined efforts of an international team of scientists including researchers from NASA's Langley Research Center and the Science and Technology Corporation, both in Hampton; Old Dominion University; the University of California at San Diego; and the University of Florida. NASA holds the patents on all derived converter technology, licensing a portion of that technology to STC Catalyst Inc., a company set up specifically to market certain catalyst applications.

"Each [institution] brought different talents to the table. That's the only way you can get one of these projects done," says George Wood, catalyst co-inventor and STC Catalyst vice president of business development. "Developing this thing was not easy. It was a hard job. It involved a lot of experimentation and testing. But the end result was that we developed a catalyst that really does work."

Beyond Theory

One immediate catalyst success has come in the form of industrial lasers, which require repeated and often costly gas recharging. Because the catalyst is able to recombine circulating gases efficiently, it can reduce replacement costs by as much as 50 percent. In operational terms, this can translate into a per-laser savings of thousands of dollars, an amount that rises substantially for businesses that use dozens of lasers for cutting, welding and drilling.

Because of greater gas-supply costs, overseas firms can save even more: perhaps tens of thousands of dollars, according to STC's Wood. His firm is aggressively pursuing marketing opportunities in Australia, Canada, France, Italy, the Czech Republic, South Africa and Japan.

"We're still in a startup mode," Wood says. "It takes maybe three years to fully develop a product. We're in our second year. Sales are good — and they're growing."

Aside from its industrial impact, the converter could have a huge effect on public health and safety. According to *The Journal of the American Medical Association*, each year unintentional carbon monoxide poisoning is estimated to cause approximately 2,100 deaths in the United States. Half of all unintentional carbon monoxide deaths could be prevented through the use of carbon monoxide detectors. The catalyst could one day function as both detector and purifier in a combined unit that would be widely available to consumers. Another conceivable use may be as part of a car's pollution-control apparatus to vastly reduce or eliminate hydrocarbon-related pollution altogether. In either case, further technology development will be required.

"There are still important issues to be resolved," Old Dominion's Brown says. "One is to improve operational efficiency in a high-humidity, ambient-temperature environment. The second is getting materials cost down. Once you do those things, the market is huge."

For Brown, the value of the catalyst project has been in the practical understanding he has been able to impart in the classroom. Beyond any commercial success, Brown believes the most profound effect may ultimately be on his pupils. "In this catalyst project we've had to decipher how things work. I've learned an awful lot from working on the catalysts and I've been able to bring that experience into the lecture hall. I'm really able to give students a practical insight that goes beyond the theory."

Catalyst co-inventors George Wood and Kenneth Brown