U.S. Patent No. 6,179,897
Better Built Metal Oxides

Karen McNulty Walsh

BNL Senior Chemist John Larese and retired BNL Chemist Walter Kunnmann were recently issued U.S. Patent No. 6,179,897 for a novel way of making metal oxides.

This class of compounds, which includes magnesium oxide —a key ingredient of numerous products, including the stomach-settling formula Milk of Magnesia™ — and zinc oxide —famous for its place on lifeguards' noses —is commonly used in catalysts and cosmetics, and is important to the growing field of nanotechnology.

The Kunnmann/Larese method for making metal oxides avoids some of the problems of traditional methods, "and allows greater control of the particle size and chemical composition of the product," says Larese.

One key difference: The traditional method requires processing a molten metal at high temperature; the newly patented method entirely avoids the dangers and difficulties of working with the liquid phase.

Instead of directly transforming the solid metal to its liquid state, "we form an intermediate compound, a metal carbide," says Larese. Then the scientists apply heat to decompose the metal carbide. The metal gets released as a vapor, which can then be oxidized to form a pure metal oxide powder.

Because the heat can be added in a controlled fashion, the scientists can vary the vapor density. The more dense the vapor, the larger the particles they produce. The result is the ability to produce metal oxide powders with uniform particle sizes anywhere from 5 to 500 nanometers.

The method also allows the scientists to add other elements such as chromium, iron, copper, and nickel to make more complex particles. These additives, or "dopants," can alter the electrical, optical, and magnetic properties of the final product, so that they can be tailored for a variety of uses. "For example, adding chromium as a dopant to magnesium oxide has resulted in a material that breaks apart certain nitrogen oxides one hundred times better than commercially available magnesium oxide," Larese says.

This reaction is important in smokestack scrubbers that aim to prevent nitrogen oxide pollutants from getting into the atmosphere. In addition, learning how to deposit metal clusters and molecules of various sizes on the surface of tiny powder particles may have applications in many other areas of materials science where scientists are trying to manipulate the physical properties of materials by creating or controlling nanoscale structures.

"I can't even imagine all the potential uses of this technique," Larese says. "Our goal right now is to explore the range of materials we can produce by this method. The excitement is going to be in discovering the things that other people haven't thought of."

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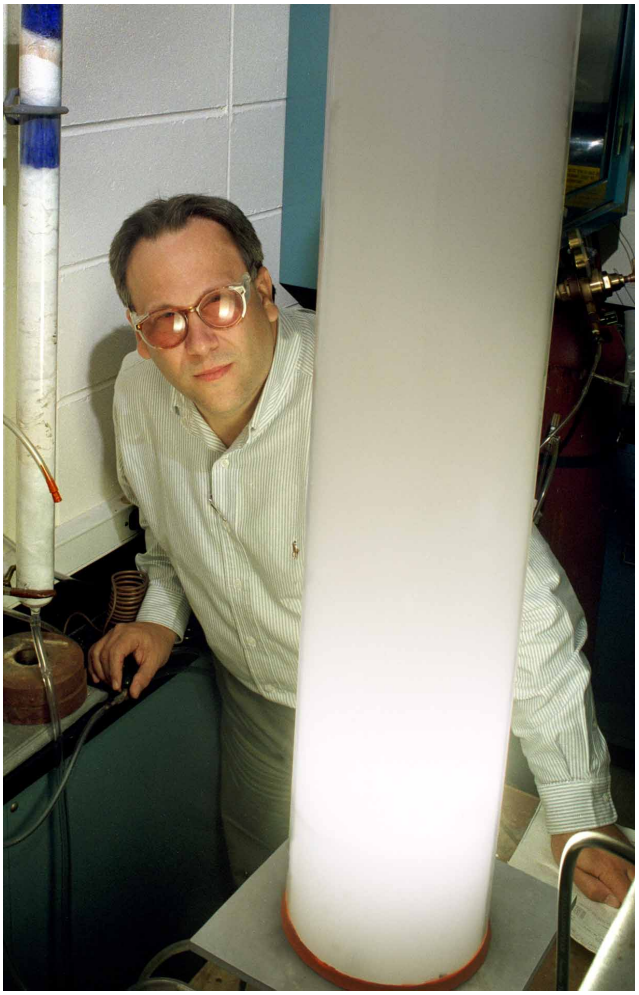

John Larese is seen with the apparatus for the patented Kauffmann/Larese method of building metal oxides. At left is a gasy-drying column, in front is the vessel in which the oxide is being produced.