used, which prevents any gas conduction through the interstitial region.

A typical approach to increase thermal contact conductance is to use thermally conducting epoxies or greases, which are not always compatible with vacuum conditions. In addition, the thermal conductivities of these compounds are often relatively low. The CNTs used in this approach can be metallic or semiconducting, depending on the folding angle and diameter. The electrical resistivity of multiwalled carbon nanotubes (MWCNTs) has been reported. MWCNTs can pass a current density and remain stable at high temperatures in air. The thermal conductivity of a MWCNT at room temperature is measured to be approximately 3,000 W/m-K, which is much larger than that of diamond. At room temperature, the thermal conductance of a 0.3 cm^2 array of CNTs was measured to be as high as 10 W/K. The high thermal conductivity and the nanoscale size make CNTs ideal as thermal interface materials.

The CNT-based thermal tape can be used for the thermal management of microelectronic packages and electronic systems. It also can be integrated with current device technology and packaging. The material would allow for an efficient method to manage excess heat generation without requiring any additional power. Lastly, the CNT tape can be used to enhance thermal contact conductance across two mating surfaces on some NASA missions.

This work was done by Ali Kashani of Atlas Scientific for Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15607-1

Two Catalysts for Selective Oxidation of Contaminant Gases

One oxidizes halocarbons and ammonia; the other oxidizes ammonia.

Lyndon B. Johnson Space Center, Houston, Texas

Two catalysts for the selective oxidation of trace amounts of contaminant gases in air have been developed for use aboard the International Space Station. These catalysts might also be useful for reducing concentrations of fumes in terrestrial industrial facilities — especially facilities that use halocarbons as solvents, refrigerant liquids, and foaming agents, as well as facilities that generate or utilize ammonia.

The first catalyst is of the supported-precious-metal type. This catalyst is highly active for the oxidation of halocarbons, hydrocarbons, and oxygenates at low concentrations in air. This catalyst is more active for the oxidation of hydrocarbons and halocarbons than are competing catalysts developed in recent years. This catalyst completely converts these airborne contaminant gases to carbon dioxide, water, and mineral acids that can be easily removed from the air, and does not make any chlorine gas in the process. The catalyst is thermally stable and is not poisoned by chlorine or fluorine atoms produced on its surface during the destruction of a halocarbon. In addition, the catalyst can selectively oxidize ammonia to nitrogen at a temperature between 200 and 260 °C, without making nitrogen oxides, which are toxic. The temperature of 260 °C is higher than the operational temperature of any other precious-metal catalyst that can selectively oxidize ammonia.

The purpose of the platinum in this catalyst is to oxidize hydrocarbons and to ensure that the oxidation of halocarbons goes to completion. However, the platinum exhibits little or no activity for initiating the destruction of halocarbons. Instead, the attack on the halocarbons is initiated by the support. The support also provides a high surface area for exposure of the platinum. Moreover, the support resists deactivation or destruction by halogens released during the destruction of halocarbons.

The second catalyst is of the supported-metal-oxide type. This catalyst can selectively oxidize ammonia to nitrogen at temperatures up to 400 °C, without producing nitrogen oxides. This catalyst converts ammonia completely to nitrogen, even when the concentration of ammonia is very low. No other catalyst is known to oxidize ammonia selectively at such a high temperature and low concentration. Both the metal oxide and the support contribute to the activity and selectivity of this catalyst.

This work was done by John D. Wright of TDA Research for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-23054-1

Nanoscale Metal Oxide Semiconductors for Gas Sensing

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A report describes the fabrication and testing of nanoscale metal oxide semiconductors (MOSs) for gas and chemical sensing. This document examines the relationship between processing approaches and resulting sensor behavior. This is a core question related to a range of applications of nanotechnology and a number of different synthesis methods are discussed: thermal evaporation-condensation (TEC), controlled oxidation, and electrospinning. Advantages and limitations of each technique are listed, providing a processing overview to developers of nanotechnology-based systems.

The results of a significant amount of testing and comparison are also described. A comparison is made between SnO_2, ZnO, and TiO_2 single-crystal nanowires and SnO_2 polycrystalline nanofibers for gas sensing. The TEC-synthesized single-crystal nanowires offer uniform crystal surfaces, resistance to sintering, and their synthesis may be done apart from the substrate. The TEC-produced nanowire response is very low, even at the operating temperature of 200 °C. In contrast, the electrospun polycrystalline nanofiber response is