Secrets of the Sea Yield Stronger Artificial Bone

When seawater freezes, crystals of pure ice form layers, while impurities such as salt and microorganisms are expelled from the forming ice and entrapped in channels between the ice crystals. The result is a layered structure that roughly resembles nacre’s wafer-like construction.

Mimicking this process, materials scientists at Lawrence Berkeley National Lab (Berkeley, Calif.) developed a porous, scaffolding-like material that is four times stronger than material currently used in synthetic bone. After creating a watery suspension of hydroxyapatite, they froze it. Just like the impurities in sea ice, the hydroxyapatite concentrated in the space between the ice crystals, creating layers and layers of nacre-like material.

When the rate of this freezing process is increased, the layered structure reduces in scale. Ultimately, the researchers obtained a microstructure that measures one micron. In comparison, nacre’s structure measures half of a micron. (Contact: Antoni P. Tomsia, tel 510-486-4918, E-mail APTomsia@lbl.gov)

Synthesizing AlN Powders

Reaction control in the combustion synthesis of AlN powder is necessary to obtain fine powders. Scientists at Osaka University (Japan) controlled the reaction by adding H₂ gas to the reactant N₂ gas, and NH₄F to the reactant mixtures. The powder obtained showed larger specific surface area, smaller average particle size, and a relatively small amount of oxygen compared with powder synthesized without additive.

The powder was synthesized with the addition of 10 vol% H₂ gas and 1.0 mass% NH₄F, and sintered using 5 mass% Y₂O₃ under 0.11 MPa of N₂ pressure at 1810°C for 180 min. The sintered AlN showed a bulk density of 3.3 g/cm³ and thermal conductivity of 160 W/mK.

AlN is one of the most promising materials for electronic devices with high circuit density. (Contact: T. Sakurai, E-mail sakurait161@ybb.ne.jp)

Ceramic-Based Sensor

Researchers at the University of Toledo (Ohio) and The Ohio State University (Columbus) have developed a novel technique for detecting low levels of CO using tungsten oxide and molybdenum oxide. According to an article in Technical Insights (Frost & Sullivan).

The technique is based on rigorous thermodynamic considerations of the metal/metal oxide (M/MO) coexistence and has resulted in a novel redox technique to enhance sensor behavior. By modulating the oxygen partial pressure across the equilibrium M/MO proximity line, formation and growth of new oxide surface on an atomic/submolecular level under conditions of “oxygen deprivation” has been achieved in potential sensor materials.

By precisely modulating the oxygen potential slightly lower or slightly higher than that existing in the vicinity of a given oxide, the scientists can cause atomic/molecular level reduction or oxidation of the given ceramic oxide. The scientists believe this is the first time the concept and technique of oxygen deprivation for such changes on the atomic/molecular level has been exploited. (Contact: Abdul-Majeed Azad, tel 419-530-8103, E-mail abdul-majeed.azad@utoledo.edu)