ARO-FE ENVIRONMENTAL Bulletin

March 2002

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HOT Green Topic on a New Ceramic Process capable of producing a high strength Photocatalitic Fiber …

The New Process: Ceramics are often prepared with surface layers of different composition from the bulk, in order to impart a specific functionality to the surface or to act as a protective layer for the bulk material. Dr.Toshihiro Ishikawa and his colleagues at the Ube Industries Research Laboratory, describe a general process by which functional surface layers with a nanometer-scale compositional gradient can be readily formed during the production of bulk ceramic components. The basis of Ube's approach is to incorporate selected low-molecular-mass additives into the precursor polymer from which (either) the ceramic forms, or the binder polymer used to prepare bulk components from ceramic powders. Thermal treatment of the resulting bodies leads to controlled phase separation (bleed out) of the additives, analogous to the normally undesirable outward loss of low-molecular-mass components from some plastics; subsequent calcinations stabilizes the compositionally changed surface region, generating a functional surface layer. This approach is applicable to a wide range of materials and morphologies, and finds use in catalysts, composites and environmental barrier coatings. Fig 1. Schematic diagram of a general process for *in situ* formation of functional surface layers on ceramics. "Precursor Ceramics" indicate precursor polymers including low molecular mass additives. "Traditional powder systems" indicate green bodies composed of ceramic powders and resins including low-molecular-mass additives.

The Photocatalitic Activity fiber (TiO_2/SiO_2) Produced by the New Process: Several experiments have confirmed the usefulness of this fiber in removing: Dioxin in the Waste Water; Legionella germ and coliform in the water; Acetaldehyde contained in the cigarette smoke, Formaldehyde and Perffluorometane (a very large greenhouse effect).

Here is an example of an experiment set up to confirm the coliform-sterilization ability of this fiber as follows: TiO_2/SiO_2 (0.2g) was placed in wastewater(20ml) containing coliform at a concentration of $2x10^6 ml^{-1}$. Irradiation by UV light (Wavelength: 352nm, $2mWcm^{-2}$) was performed at room temperature, and a small amount of the wastewater was extracted every hour. After cultivation using the extracted water, the amount of active coliform was calculated from the number of colonies formed. In this experiment, all of the coliform in the wastewater was completely sterilized within three hours. In the comparative study (with no fiber), the coliform content markedly increased to $3x10^7$ ml^{-1} under the same conditions

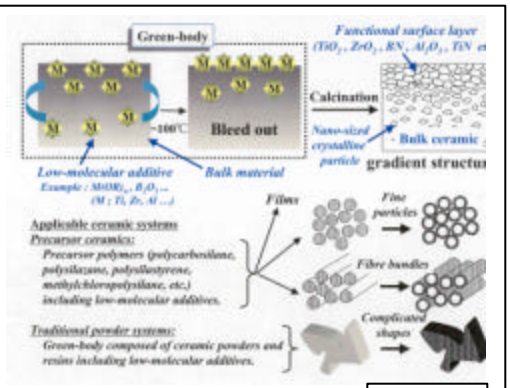

Fig. 1

Click on the PP document to view the slides presented by Dr. Toshihiro Ishikawa at the first US-Japan Workshop on "Low Cost Production of Ceramics and Related Materials" held on 17-20 March 2002 at Osaka, Japan. The Workshop was sponsored by the Tri-Service Far East Offices and organized by Professors K. Niihara of Osaka Univ and R.E. Tressler from Penn State Univ. & Dr. Giuliano D'Andrea from ARO-FE.

T.Ishikawa.pdf

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