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Ceramic fibers with functional surface layers synthesized from polycarbosilane containing low-molecular mass additives

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Abstract

We have developed functional ceramics by precursor methods using polycarbosilane $(-SiH(CH_3)-CH_2-)_n$ which is representative pre-ceramic polymer for preparing SiC ceramics, for example, Hi-Nicalon fiber and Tyranno SA fiber. Furthermore, silica-based fibers can also be produced from the polycarbosilane by firing in air. Our unique technology makes full use of the bleed-out phenomenon of low molecular mass additives intentionally mixed in the polycarbosilane. Here, we have treated a polycarbosilane with $Ti(OC_4H_9)_4$ or $Zr(OC_4H_9)_4$, and have created a strong, fibrous photocatalyst with a surface TiO_2 nano-layer, or a highly alkali-resistant (and excellent oxidation-resistant) SiC-based fiber with a surface ZrO_2 nano-layer. And also, we developed a new concept for creating surface meso-pores in which noble metals are selectively deposited by photoelectrical deposition. The meso-pores are formed in the interstices between crystal-arrays composed of sintered photoactive nano-crystals whose boundaries are strictly controlled for creating continuous coherent bonds. Furthermore, in the recess of the pore, a heterogeneous insulator phase exists. The aforementioned coherent crystalline structure causes a smooth electron flow from the outside to the inside of the array through the coherent boundaries of the nano-crystals during photo-deposition accompanied by the outside-hole consumption and noble metal deposition in the recesses of the surface meso-pores. We created this structure by a natural phenomenon. Our new concept is applicable to a wide range of functional materials, and should find use in the preparation of excellent photocatalysts, redox catalysts and photochromic materials. In this paper, the unique production process and the characteristics of the obtained fibers will be discussed.

Biography

Ishikawa is Fellow of Ube Industries, Ltd. And also, he is Academician of world academy of ceramic and Fellow of American Ceramic Society. Dr. Ishikawa has conducted very important research & development on SiC-based fibers, composite materials, and nano-sized-titania/silica-based photocatalytic fibers, and so force. Regarding these researches, Dr. Ishikawa has published more than 100 papers including two ***Nature*** papers and one ***Science***. Dr. Ishikawa received lots of award and prize, for example: Yamazaki Teiichi Prize, Award from the Minister for Environment.