Synthesis and Characterization of Ultrafine Silicon Nitride Powder Produced by a Hybrid Plasma Technique

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Ultrafine powder of silicon nitride has been synthesized from the system $SiCl_4$-H_2-NH_3 in a hybrid plasma at the production rate of 100 g/h. The powder was white and fluffy. The X-ray diffraction pattern and the infrared absorption spectrum showed that the ultrafine powder was amorphous Si_3N_4. The crystallization temperature was as high as 1500°C which suggests the high purity of the powder. Chemical composition of the powder was $Si_3N_{3.88}O_{0.35}H_{0.19}$ and the presence of silicon diimide was not detected. The specific surface area of the powder was 60-70 m^2/g and the particle diameter was expected about 300 Å. The powder particles were spherical and the surface was covered with oxidized film of 6-7 Å in thickness. It was observed that amorphous Si_3N_4 ultrafine powder was gradually oxidized in air. [Received July 31, 1985]

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Preparation of Si_3N_4-SiC Films by Plasma CVD

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This paper reports Si_3N_4-SiC films prepared by plasma CVD from SiH_4(90% Ar), NH_3, C_2H_4 and H_2 gas mixtures. Compositions of the films were varied roughly from stoichiometric Si_3N_4 to SiC by changing the flow rate ratio of these gases. Amorphous films with smooth surface were prepared under the pressure of 66.7 Pa(0.5 Torr) at 400°C and a deposition rate about 0.4 $nm \cdot sec^{-1}$. Properties of the films such as thickness, composition, refractive index, structure, texture, infrared absorption and visible ultraviolet absorption spectra were evaluated. Nitrogen and carbon contents in the films were found to be proportional to the flow rate ratio of the raw gases. The wave number of infrared absorption peak shifted from 860(Si-N bond) to 780(Si-C bond)cm^{-1} with increasing carbon content in the films. The optical band gap determined from visible ultraviolet absorption edge shifted from 3.7(Si_3N_4) to 2.4(SiC)eV, also. From above results and TEM observations, it is anticipated that nitrogen and carbon atoms in the films are distributed in an atomic scale in contrast to those in Si_3N_4-C ceramics hitherto prepared by pyrolytic CVD. [Received August 19, 1985]

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