Characterization of SiCN Catalytic Chemical Vapor Deposition Film Coatings

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Polymer derived ceramic materials such as SiCN is gaining momentum because of its excellent thermo-mechanical properties at high temperatures. In addition, the electrical conductivity of SiCN can be tailored and characterized to suit specific application needs. These excellent properties make SiCN a best choice for sensor applications. SiCN has been used for making heat flux sensors (Nagaiah et al., 2006); health monitoring sensors for turbines and power generation systems (Sporian, 2007) and high temperature pressure transducers (Andronenko et al., 2005). For high temperature, corrosive and harsh environment applications in the agricultural and food industry, SiCN based sensors are preferred.

Experimental methods for making thin films of SiCN to facilitate sensor fabrication are being researched worldwide. Radio frequency magnetron sputtering (Xie et al., 2003; Sundaram et al., 2004), pulsed laser deposition (Park et al., 2003), plasma enhanced CVD (Fisher et al., 2007), microwave plasma enhanced CVD and electron cyclotron resonance plasma CVD (Chen et al., 1999) and other methods of depositing SiCN have been explored. Unlike the above high temperature deposition techniques, decrease in the temperature can decrease processing costs, reduce thermally induced stress on the substrate and allow faster heat-up, cool down of the deposition process. Influence of decreased temperature also results in increased resistivity parameter of the material.

In our study, deposition of SiCN film using HMDS by catalytic CVD for low temperature deposition is being explored. Thin films of SiCN were deposited on a silicon substrate using ammonia and hydrogen gas sources. Compositions of SiCN were varied by changing the ammonia gas. Nano-mechanical properties of thin films of SiCN were determined using nano indentation module. Surface morphology of the films was characterized by using Atomic Force Microscope. X-ray Photoelectron Spectroscopy was used to analyse the incorporation of nitrogen in SiC layers grown on the substrate at different gas flow rates. The results showed that composition ratio of SiCN and the dielectric constant can be controlled by varying the flow rate of ammonia. The results of the structural as well as electrical characterization of SiCN under different concentrations of CO2 are also presented in this study.

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