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Thesis Announcement

Synthesis of Boron Oxynitride, an emerging dielectric, for use in High Temperature Capacitor Applications

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Military and commercial applications such as directed-energy weapons, automotive, and well logging require high temperature electronics which operate at temperatures of 200°C and more. Among the many technical challenges encountered in the development of high temperature electronics, the role of a passive component like capacitor is very important. Dielectric integrity at high temperature has been one of the major impediments to bringing out a capacitor with suitable performance characteristics at high temperature. The need for a dielectric material with stable performance at high temperatures has been under investigation for a long time. In this work, Boron Oxynitride material has been synthesized by an insitu, defect free process and its material properties have been studied by techniques such as SEM, XRD and XPS.

Ion source assisted Physical Vapor Deposition is used to grow Boron Oxynitride films. Nitrous oxide N_2O is used as the feed gas to the ion source and solid boron is sublimated using an electron beam. Deposition is on 2" Si wafers. The pressure during growth is 10^{-6} torr and growth has been done for a range of wafer (substrate) temperatures (500°C-600°C). Samples of thickness varying from 50nm – 1µm have been made. Prototype capacitors with Boron Oxynitride as dielectric have been fabricated. Electrical and Thermal Characterization of the devices have been performed. Preliminary results indicate a very small variation (~1%) of capacitance over a range of frequencies (10 KHz – 2 MHz) and a 12% variation in capacitance over a range of temperatures (25°C-400°C). Leakage current measurements were performed and the breakdown voltage has been determined. Device degradation test have also been performed and the capacitors show very good stability at high temperature of 400^{o}C. The conditions of the Boron Oxynitride dielectric growth have been optimized for Ion source assisted Physical Vapor Deposition.

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