Polymer-derived ceramics (PDCs) are a unique class of multifunctional materials synthesized by thermal decomposition of polymeric precursors. Due to their unique and excellent properties and flexible manufacturing capability, PDCs are promising for making ceramic fibers, coatings, composites and micro-sensors for high-temperature applications. However, structure-property relationships of PDCs have not been well understood. The lack of such understandings drastically limited the further developments and applications of the materials. In this dissertation, the structure and properties of polymer-derived amorphous silicon carbonitride (SiCN) and silicoboron carbonitride (SiBCN) have been studied. The SiCN was obtained using commercially available polysilazane as the precursor, and SiBCNs with varied Si-to-B ratio were obtained from polyborosilazanes, which were synthesized by the hydroboration and dehydrocoupling reaction of borane and polysilazane. The structure evolution from polymer to ceramics was investigated by NMR, FTIR, Raman, EPR, TG/DTA, and XRD. The electric and dielectric properties of the SiCN and SiBCNs were studied by I-V curves, impedance spectroscopy, LCR Meter, and network analyzer. A new electronic conduction mechanism and structure model have been proposed to account for the observed relationships of the properties and microstructure of the materials.

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The public is welcome to attend.