Dense SilicoBoronCarboNitride pieces: from Chemistry andProcessing of Boron-Modified Polycarbosilazanes to preparation and characterization of final materials

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Silicon-based non-oxide ceramics (SiC, Si_3N_4) have attracted much attention, primarily due to their good mechanical and chemical properties, and also their reliability at room and elevated temperatures. They have great potential for many industrial uses as engineering components. The addition of a second ceramic (nano)phase to SiC or Si_3N_4 leads to materials which promise applications in many fields and offer solutions forthe market demands. However, the preparation of these materials is still a challenging task according to the fact that conventional processes unavoidably lead to size and structure inhomogeneities of the different phases and presence of impurities which affect the properties. Here, we propose an alternative strategy using a "ceramic through chemistry" concept. The Polymer-Derived Ceramics (PDCs) route is an attractive means for the design of advanced ceramics; in particular in non-oxide systems. Preceramic polymers are of great interest as they allow obtaining multi-element ceramics with controlled chemical composition and depending on the composition, they can provide high temperature resistant materials.

In this study, boron is added to polycarbosilazanes to obtain silicoboroncarbonitride (Si/B/(C)/N) ceramics after pyrolysis.In this presentation, we will investigate through FTIR and solid-state NMR, the chemistry of boron-modified polycarbosilazanes, as well as their pyrolysis behavior combining TG experiments and solid-state NMR. By controlling the boron content in the polymer at molecular scale, we can deliver after pyrolysis dense Si/B/(C)/N materials with tailored properties. The high temperature behavior is investigated by thermogravimetric analysis, XRD, elementalanalysis and Raman spectroscopy and we show how the boron content as well as the nature of the atmosphere affect the structural evolution of the Si/B/(C)/N phase at high temperature.