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Transformation of Organosilicon Polymer to SiOC Glass in Different Atmospheres

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Abstract

Polymer-derived glasses are a unique class of amorphous materials obtained through the pyrolysis of an organosilicon polymer in a controlled atmosphere. The structure and chemistry of those glasses can be precisely tailored by adjustments in composition, as well as changes in processing parameters such as pyrolysis time, temperature, and atmosphere. In this study, the transformation of methyl polysiloxane into a SiOC in an inert Ar and reactive CO_2 environment was investigated by utilizing a range of complementary characterization techniques. Since the kinetics of porosity evolution were influenced by the glass compositions, densification proceeded more rapidly in the reactive CO_2 environment, where the matrix closely resembles SiO2. At the highest pyrolysis temperature, the SiOC glass produced in Ar exhibited a higher density than those obtained in CO_2. The mechanical properties and thermal conductivity were improved with increasing pyrolysis temperature by the structural modifications and were generally found to be higher in the Ar environment.