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High-Surface-Area Porous SiOC-Bonded SiC Fabricated at 800 °C via a Polymer-Derived Route

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Introduction

Porous ceramics are used in filtration, catalysis, and separation processes. Membrane systems are relevant to water and wastewater treatment (1). Silicon carbide (SiC) combines mechanical strength, thermal stability, and chemical resistance, making it an attractive material for porous supports (2). However, conventional SiC processing often requires temperatures above 2000 °C, increasing energy demand. Polymer-derived ceramic (PDC) routes offer an alternative, enabling SiOC bonding phases at lower temperatures (750–1000 °C) and allowing tailored pore architecture through sacrificial pore formers (3).

Objective

This study aims to develop porous SiOC-bonded SiC ceramics at 800 °C via a polymer-derived route and evaluate the effect of dextrin content on porosity, specific surface area, and mechanical properties.

Methodology

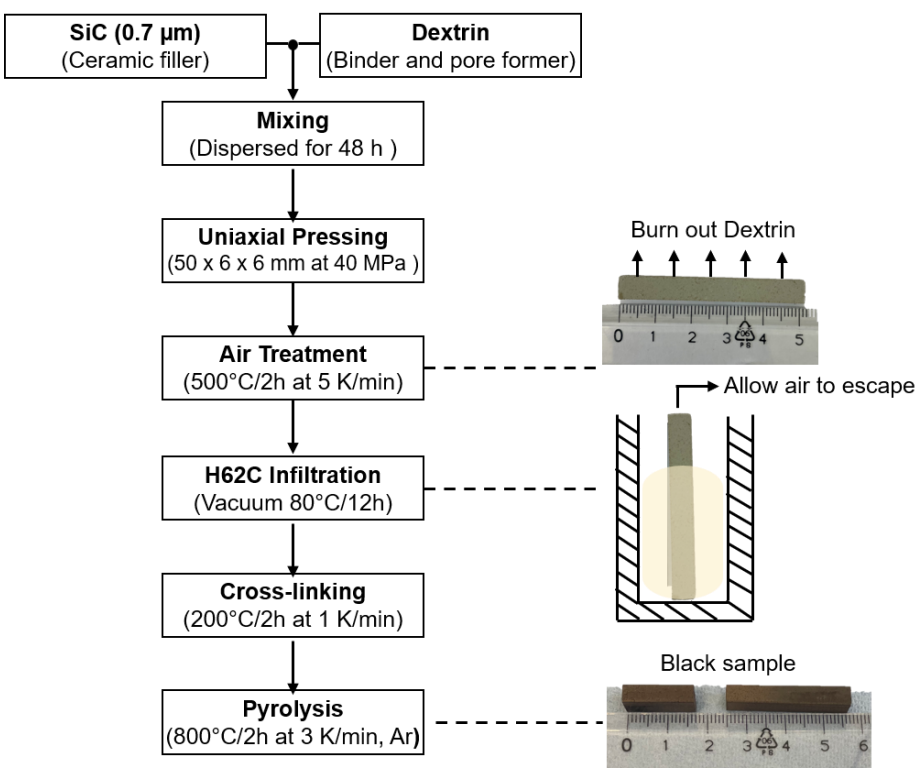


Figure 1. Process diagram for the fabrication of SiOC-bonded SiC ceramics.

Results and Discussion

Processing at 800 °C yielded SiOC-bonded SiC with tunable porosity (Fig. 2), combining a high specific surface area of 220 m²/g with flexural strengths from 28 to 39 MPa (Table 1).

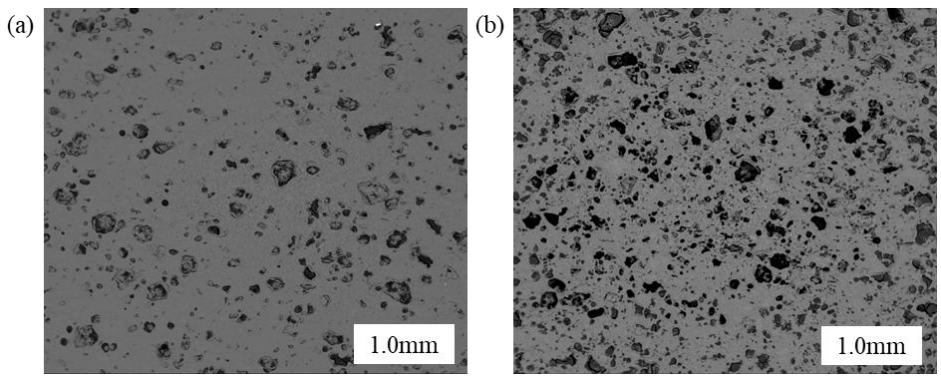


Figure 2. SEM images of polymer-infiltrated samples after the final heat treatment at 800 °C, prepared with (a) 20 vol% and (b) 40 vol% dextrin as the pore former.

Table 1. Key characteristics of porous SiOC-bonded SiC ceramics.

Property	20 vol% dextrin	40 vol% dextrin
Accessible porosity (%)	20.6	26.2
BET surface area (m²/g)	220	220
Flexural strength (MPa)	39 ± 3.2	28 ± 2.1
Young's modulus (GPa)	45.3 ± 0.2	34.5 ± 0.3

Conclusions

Porous SiOC-bonded SiC ceramics were fabricated at 800 °C via a polymer-derived route using dextrin as a pore-sacrificial agent. The SiOC phase bonded SiC particles at low temperature. Dextrin enabled control of the hierarchical pore structure. Higher dextrin content increased accessible porosity however, reduced flexural strength and Young's modulus. Both compositions achieved a surface area of 220 m²/g, with mean flexural strengths ranging from 28 to 39 MPa. These properties suggest potential as porous supports for catalytic and adsorption applications.

References and Acknowledgements

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