



HAL
open science

Editorial special issue “Polymer-Derived Ceramics (PDCs): From preceramic polymer chemistry to functional materials”

Zhaoju Yu, Ravi N.V. Kumar, Günter Motz, Rajendra Bordia, Samuel Bernard

► To cite this version:

Zhaoju Yu, Ravi N.V. Kumar, Günter Motz, Rajendra Bordia, Samuel Bernard. Editorial special issue “Polymer-Derived Ceramics (PDCs): From preceramic polymer chemistry to functional materials”. *Open Ceramics*, 2024, 17, pp.100510. 10.1016/j.oceram.2023.100510 . hal-04778596

HAL Id: hal-04778596

<https://cnrs.hal.science/hal-04778596v1>

Submitted on 15 Nov 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Public Domain



Editorial special issue “Polymer-Derived Ceramics (PDCs): From preceramic polymer chemistry to functional materials”

Open Ceramics, the official, peer-reviewed, Open Access journal of the European Ceramic Society, published by Elsevier, has published a special issue devoted to Polymer-Derived Ceramics (PDCs).

One of the main challenges in materials science is to find effective strategies to organize and design the matter from atomistic to macroscopic scale, which is a unique attribute of chemistry-based technologies, such as those based on well-defined molecular and polymeric precursors. It addresses some of the limitations (compositions, microstructures, shapes, ...) of ceramic manufacturing using conventional powder-based technologies.

Precursor routes allow a precise control over the chemical compositions, microstructure and functionality of advanced inorganic materials including oxide and non-oxide ceramics. In addition, they provide large opportunities to design and produce complex shapes more efficiently and easily compared to other ceramic shaping technologies.

In this respect, the Polymer-Derived Ceramics (PDCs) route has emerged as an important route for preparing inorganic materials including advanced ceramics for diverse applications. This approach allows designing (*à la carte*) such materials while controlling their structure, texture, shape, and their physicochemical and functional properties. The strength of this process lies in the selection and tailored synthesis of the molecular precursor (elementary building block, elemental composition) and the conditions under which the material evolves towards a preceramic polymer and then a ceramic-based material with the following benefits:

- highest purity of final materials compared with those obtained by traditional powder technology because of the use of molecules in the early stage of the process allowing easy purification of the reacting species,
- controlled shapes can be produced at all length scales because of the possibility to adjust the physical state and rheological properties of preceramic polymers to be shaped using the same methods as for organic polymers or plastics,
- possibility to produce a variety of chemical compositions including nitrides, carbides, multi-component systems and hybrid (organic-inorganic, metal-ceramic) materials,
- high control of the homogeneity, atomic distribution and microstructure of final materials,
- targeted generation of functional properties.

From the pioneering works published in the 70's, the PDCs route has become a preferred approach for the design and commercial production of ceramic fibers – based on silicon carbide (SiC). The progress in the last

few decades has been very significant, and has allowed expanding the boundaries of this field towards novel materials (in terms of compositions, microstructure and shapes), designed properties and broad applications.

The main purpose of this Special Issue (SI) is to highlight the potential of the preceramic polymers as a unique and versatile way for preparing advanced inorganic materials. This SI addresses current progress in all aspects of PDCs from preceramic polymer chemistry to functional materials. Special focus is given to the relationship between the polymer chemistry (through synthesis and/or chemical modification) and processing conditions, leading to the desired structure at different length scales and the properties of the resulting ceramic. This SI includes papers on specific topics such as polymer synthesis, shaping, polymer-to-ceramic conversion and advanced characterization, which pave the way towards functional materials. Specifically, this SI includes contributions on following topics:

- synthesis of preceramic polymers and/or modification of preformed polymers,
- shaping including the design of coatings and complex 3D parts by additive manufacturing,
- advanced characterization of materials,
- development of functional properties including those for energy conversion and storage.

After a peer-review process, the total number of papers published in this SI is 12 from all over the world.

As guest editors of this issue, we would like to sincerely thank the interest and support of all the authors that contributed to this SI, the reviewers for their constructive comments, the editorial staff members of Elsevier for their editorial support and the Editor in Chief of Open Ceramics, Prof. Paolo Colombo, for given us this opportunity to edit this collection of feature articles dedicated to PDCs.

Zhaoju Yu
Xiamen University, College of Materials, China

Ravi N.V. Kumar
Indian Institute of Technology Madras, Laboratory for High Performance Ceramics, Department of Metallurgical & Materials Engineering, India

Günter Motz
University of Bayreuth, Ceramic Materials Engineering Guenter, Germany

<https://doi.org/10.1016/j.oceram.2023.100510>

Rajendra K. Bordia
University of Clemson, Materials Science and Engineering, United States

Samuel Bernard*
CNRS-University of Limoges, Institute of Research for Ceramics, France

* Corresponding author.
E-mail address: samuel.bernard@unilim.fr (S. Bernard).