Preceramic Polymers as Precursor for implantable MEMS Applications

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1. Summary

Polymer-derived ceramics (PDCs) offer a variety of unique features that outperform classical powder-sintered ceramics and make PDCs valuable candidates for challenging applications such as implantable MEMS. The precise controllability of the precursors’ chemical composition allows the adjustment of the functional properties such as the electrical conductivity. Well-known PDC systems are being customized and shaped in a way not being possible before by a sophisticated combination of various advanced microfabrication techniques such as photolithography, 2PP 3D printing, and thermal scanning probe lithography. Continuing the research of a former CTI & SNSF project and resorting to a comprehensive study of the curing and pyrolysis processes of polysilazanes, the current collaborative project Ceramic X.0 targets the fabrication and evaluation of novel ceramics with unique properties and advanced shapes.

2. Polysilazanes and their derived ceramics

<table>
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<tr>
<th>Temperature (°C)</th>
<th>Transformation process</th>
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<tbody>
<tr>
<td>1033</td>
<td>Formation of amorphous covalent ceramics</td>
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<tr>
<td>1500</td>
<td>Polymer-to-ceramic transformation (500-1400°C)</td>
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<tr>
<td>1800</td>
<td>Evolution of remaining organic moieties</td>
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<tr>
<td></td>
<td>- Formation of amorphous covalent ceramics HT Annealing (1000-2200°C)</td>
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<td>- Transformation into (poly)crystalline materials</td>
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Precursor Preparation: optional chemical modification; optional addition of filler(s), photoinitiator(s), and catalyst(s); optional physical blending; homogenization

3. Transformation processes

- Transformation into (poly)crystalline materials
- Formation of amorphous covalent ceramics
- Evolution of remaining organic moieties
- Transformation into (poly)crystalline materials

Example: Durazane 1500

4. Further eligible precursors

5. Micro-manufacturing processes

Precursor Preparation: optional chemical modification; optional addition of filler(s), photoinitiator(s), and catalyst(s); optional physical blending; homogenization

6. Target applications

- Implantable (biocompatible)
- Micro- / nano-mechanical components

Example: Durazane 1500

7. References


8. Acknowledgments

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