



## Hybrid Organic-Inorganic Biomaterials with Self-Healing Properties

Fan, Wei; Smedskjær, Morten Mattrup; Yu, Donghong; Youngman, Randall E.

*Publication date:*  
2021

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*

Fan, W., Smedskjær, M. M., Yu, D., & Youngman, R. E. (2021). *Hybrid Organic-Inorganic Biomaterials with Self-Healing Properties*. Abstract from 14th Pacific Rim Conference on Ceramic and Glass Technology, Vancouver, Canada.

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

### Take down policy

If you believe that this document breaches copyright please contact us at [vbn@aub.aau.dk](mailto:vbn@aub.aau.dk) providing details, and we will remove access to the work immediately and investigate your claim.

## Hybrid Organic-Inorganic Biomaterials with Self-Healing Properties

Wei Fan<sup>1</sup>, Morten M. Smedskjaer<sup>1</sup>, Donghong Yu<sup>1</sup>, Randall E. Youngman<sup>2</sup>

<sup>1</sup> *Department of Chemistry and Bioscience, Aalborg University, 9220 Aalborg, Denmark*

<sup>2</sup> *Corning Incorporated, USA*

**ABSTRACT:** In some biomaterial applications there is a need for the devices to withstand cyclic loading. A recent discovery of a self-healing hybrid system with interpenetrating-networks of organic and inorganic components is investigated further in this work, as there is a need to better understand their structure-mechanical property relations. Specifically, we report on a series of silica-poly(tetrahydropyran)-poly( $\epsilon$ -caprolactone) (SiO<sub>2</sub>-PTHP-PCL-diCOOH) materials, which are prepared through a three-step synthesis, including *in situ* cationic ring-opening polymerization, sol-gel reaction, and polymer-silica condensation. We use THP as the main constituent of the organic phase, which can be polymerized under mild conditions. Additionally, we control the degree of silica-crosslinking and the organic-inorganic ratio. The thermal stability, density as well as Young's modulus could also be regulated through such control. Of particular interest, the hybrid materials with certain organic polymer content above 73% show apparent self-healing ability, likely due to the reversible intermolecular forces and hydrogen bonding among the polymer chains. Finally, we discover that the PTHP-SiO<sub>2</sub> networks are stable in bio-like circumstances although PCL undergoes biodegradation. The present structural control approach could lead to the design of tailored functional hybrids, with potential applications within soft robotics and bone regeneration.

Reference: Fan W., Youngman R. E., Ren X., Yu D., Smedskjaer M. M. Structural Control of Self-Healing Silica-Poly(Tetrahydropyran)-Poly( $\epsilon$ -caprolactone) Hybrids. *Journal of Materials Chemistry B* **9**, 4400-4410 (2021).