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#ICMolTalks

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Assembly hall

Abstract

Glasses and Porous Liquids Based on Metal-Organic Frameworks

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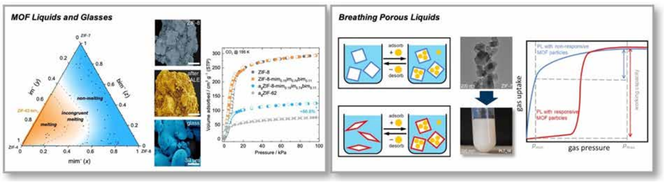
The amorphous state of metal-organic frameworks (MOFs) reveals unique properties like responsiveness, meltability, and glass formation, with MOF liquids particularly notable for their moldability and vitrification into diverse shapes. [1]. This presentation focuses on liquid and glassy MOFs, especially the zeolitic imidazolate framework (ZIF) family, discussing how chemical design tunes their thermal and mechanical properties, such as melting points and glass transition temperatures.[2] Additionally, we examine how intrinsic porosity in ZIF glasses depends on their molecular building blocks and precursor topologies, with potential applications in kinetic gas separation, such as propylene-propane separation.[3] We will also introduce recent advancements in modifying MOF glasses in their liquid state, demonstrating initial chemical reactions like ligand incorporation, exchange, and salt dissolution.
In the second part, we present a new class of MOF-based fluid composites: breathing porous liquids (bPLs). These comprise gas-responsive MOF particles in silicone oil that mimic haemoglobin's cooperative gas-binding. This unique breathing behaviour suggests applications in gas separation processes, such as CO_2 scrubbing from flue gas.[4] This talk highlights the chemistry of MOF liquids, glasses, and composites, showcasing their potential for innovative technological applications.



[1] a) N. Ma, S. Horike, Chem. Rev. 2022, 122, 4163; b) T. D. Bennett, S. Horike, Nat. Rev. Mater. 2018, 3, 431; c) T. D. Bennett, F.-X. Coudert, et al. Nat. Mater. 2021, 20, 1179.
[2] a) L. Frentzel-Beyme, S. Henke, et al. J. Am. Chem. Soc. 2019, 141, 12362; b) J. Song, S. Henke, et al. Angew. Chem. Int. Ed. 2022, 61, e202117565; c) J. Song, S. Henke, et al. J. Am. Chem. Soc. 2023, 145, 9273.
[3] a) L. Frentzel-Beyme, S. Henke, et al. Nat. Commun. 2022, 13, 7750; b) W.-L. Xue, S. Henke, et al. Angew. Chem. Int. Ed. 2024, e202405307; c) W.-L. Xue, S. Henke, et al. Nat. Commun. 2024, 15, 4420.
[4] A. Koutsianos, S. Henke, et al. Nat. Commun. 2023, 14, 4200.

Biography

Sebastian Henke studied Chemistry at Ruhr-University Bochum, Germany, from 2003 to 2007. He completed his PhD in Materials Chemistry in 2011 with fellowships from the German Chemical Industry Fonds and the Ruhr University Research School under the mentorship of Prof. Roland A. Fischer. Following his doctoral studies, he was a Postdoctoral Fellow of the Humboldt Foundation at the University of Cambridge, UK, working with Prof. Sir A. K. Cheetham from 2012 to 2014. Sebastian returned to Ruhr University Bochum as an Independent Researcher and Fellow of the Humboldt Foundation from 2014 to 2015 before transitioning to industry as a Project Manager and Technology Expert in Germany. In 2016, he joined TU Dortmund as a Junior Professor of Materials Chemistry and was promoted to Professor in 2021.
He has received several distinctions, including the MERCUR Start-Up Grant (2018), the Max-Buchner-Scholarship of DECHEMA (2018), and the Teaching Award of TU Dortmund in 2021. In 2022, the student representatives of the Department of Chemistry and Chemical Biology, TU Dortmund, honoured him with the Best Lecturer Award.

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