

On-Surface Synthesis of Monolayer and Bilayer Covalent Organic Frameworks Monitored Using Ambient Scanning Tunneling Microscopy.

Steven De Feyter

Department of Chemistry, KU Leuven, Celestijnenlaan 200F, Leuven, Belgium

Steven.defeyter@kuleuven.be

Deciphering the structure and dynamics underlying the formation of covalent organic-based 2D crystalline materials is crucial for controlling their quality, including defect density and dimensions. A comprehensive understanding of these characteristics is essential for fine-tuning their properties.

In this work, we highlight the application of scanning probe microscopy—specifically scanning tunneling microscopy (STM)—to explore the structure and behavior of substrate-supported metal organic frameworks (MOFs) [1] and covalent organic frameworks (sCOFs) at the liquid-solid interface [2-5].

We delve into the growth of monolayer sCOFs, focusing on the real-time observation of nucleation and growth processes [2]. Additionally, we explore methods to induce and regulate multilayer formation [3,4]. Notably, we also investigate the role of the electric field generated by the STM tip in triggering and controlling (de)polymerization processes [5].

References

- [1] A. Cucinotta, S. Eyley, J. A. Davies, W. Thielemans, K. S. Mali, and S. De Feyter, *J. Am. Chem. Soc.*, 47, (2025) 7682
- [2] G. Zhan, Z.-F. Cai, K. Strutyński, L. Yu, N. Herrmann, M. Martínez-Abadía, M. Melle-Franco, A. Mateo-Alonso, and S. De Feyter, *Nature* 603, (2022), 835
- [3] G. Zhan, B. Koek, Y. Yuan, Y. Liu, V. Mishra, V. Lenzi, K. Strutyński, C. Li, R. Zhang, X. Zhou, H. Seob Choi, Z.-F. Cai, J. Almarza, K. S. Mali, A. Mateo-Alonso, M. Melle Franco, Y. Zhu, S. De Feyter, and K. P. Loh, *Nature Chemistry*, 17, (2025) 518
- [4] J. Sun, G. Feng, K. Strutyński, G. Velpula, S. Yuan, M. Melle-Franco, K. S. Mali, S. De Feyter, *J. Am. Chem. Soc.*, 148 (2026) 11683
- [5] G. Feng, Q. Zhang, V. Mishra, K. S. Mali, S. Lei, S. De Feyter, *J. Am. Chem. Soc.*, 148 (2026) 11145

Figures

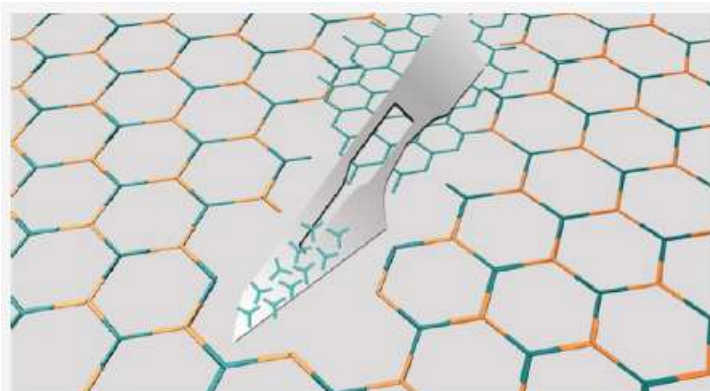


Figure 1: Scalpel for Programmable Cleavage and Reconfiguration of Monolayer COFs