



Unlocking Material Processability: Harnessing Imine-Based Covalent Organic Framework Gels

Prof. Félix Zamora



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Abstract

Covalent Organic Frameworks (COFs) represent a promising category of materials characterized by their ordered porosity, formed through condensation reactions of organic molecules. Recently, the exploration of Schiff-base or dynamic imine chemistry has emerged as a prominent avenue for synthesizing novel COFs. This shift is motivated by their enhanced chemical stability, porosity, and crystallinity compared to previously reported structures, such as boronate ester-based COFs. While extensive research has focused on chemical design, as well as thermal and chemical stability, the aspect of COF processability remains relatively underdeveloped, despite its fundamental importance for numerous applications.^[1,2]

This presentation delves into the latest advancements in synthesizing imine-based COFs to facilitate their processability. Specifically, the discussion will center on the formation of imine-based COF gels^[3,4,5], which can subsequently be transformed into aerogels and films, thereby enabling the creation of functional membranes spanning centimeters in length. I will also show progresses on controlled COFs aggregation allows formation of COF gels and adjusting parameters the direct process of 3D printing^[6]. These advancements highlight the potential for tailored design and processing of imine-based COFs, paving the way for their diverse applications as energy storage. I will show some recent examples of the use of COF aerogels to produce flexible energy storage devices^[4].

References

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[3] C. Franco, D. Rodríguez-San-Miguel, et al. J. Am. Chem. Soc. 2020, 142, 3540-3547.
[4] J. Á. Martín-Illán, et al. Angew. Chem. Int. Ed. 2021, 60, 13969–13977.
[5] J. Á. Martín-Illán, et al. Adv. Sci. 2022, 2104643.
[6] S. Royuela et al. Adv. Func. Mater 2023, 2314634.

Biosketch

Félix Zamora (Universidad Autónoma de Madrid; UAM) is a Full Professor at the Department of Inorganic Chemistry of UAM and Vice-Rector for Innovation at the same university. He received his PhD in 1994 at UAM under the supervision of Prof. C. Navarro-Ranninger. After a postdoctoral stay in University of Dortmund (Germany) with Prof. Bernhard Lippert; and in University of Virginia (USA) with Dr. Michal Sabat, he rejoined the UAM, where he became “Profesor Titular” in 2002 and “Catedrático” in 2020 at the Inorganic Chemistry Department. He is also research associate member of IMDEA Nanoscience Foundation, Institute for Advanced Research in Chemical Sciences (IAdChem), and Condensed Matter Physics Institute Center (IFIMAC). He has been awarded by the Spanish Royal Society of Chemistry with Research Excellence Award in 2015.

From 2004, he is Principal Investigator of the research group “Nanomaterials Lab” (7 PhDs, 2 postdocs, 4 Professors). He is author of +200 papers in top-tier journals (e.g. Nature Nanotech., J. Am. Chem. Soc., Angew. Chem., Adv Mater, etc), 4 book chapters and 8 patents (+15000 citations, h-index = 58, GS). He acts as active evaluator of several scientific organisations (e.g. National Science Foundation-USA, Swiss National Science Foundation, FNRS Belgium, etc). Member of the RESPORE (the Ile-de-France network in porous solids science) international Advisor Committee.

His current research lines are focused on covalent organic frameworks (COFs), 2D-materials and coordination polymers with a notable distinction for developing viable applications.

He has spent several periods of time as a visiting professor at the Nanoscience Laboratory (University of Newcastle), at the Chemistry Department of the National University of Singapore and at the Singapore Graphene Center.

Since 2013 member of the editorial panel of Scientific Reports (Nature Publishing Group), and from 2017 of the journals: General Chemistry Journal and Nanomaterials Journal.

He has developed projects with several companies Abengoa Research, Nanoinnova Tech., Repsol, etc. He is founder and scientific advisor of the company Nanoinnova Technologies (spin-off of the UAM, www.nanoinnova.com). He is also cofounder and scientific advisor of Nanoinnova Technologies (www.nanoinnova.com).