

From Crystallinity to Circularity: Covalent Organic Framework Chemistry for Selective Recovery of Valuable Metals from E-Waste

Abstract

Covalent organic frameworks (COFs) are rapidly emerging as one of the most powerful classes of porous crystalline materials for next-generation separation, adsorption, and resource-recovery technologies. This talk will highlight the collective contributions in advancing COF chemistry from fundamental structure control to targeted applications in metal capture and e-waste valorization. A central theme of this body of work is that the performance of COFs is governed not only by surface area and porosity, but also by the precise control of crystallinity, linkage chemistry, and postsynthetic modification. In particular, recent studies demonstrate that carefully designed synthetic and catalytic routes can produce highly crystalline imine- and azine-linked COFs under milder and faster conditions, while postsynthetic modification can introduce functional groups without sacrificing the ordered porous framework. This chemical versatility enables the rational design of COFs with strong affinity for specific species, as shown by magnetic functionalized COFs for ultrafast Hg(II) capture and, more importantly, N-heterocyclic carbene-modified COFs that display high selectivity toward Au(III) and enable efficient gold recovery from complex e-waste matrices. These advances establish a clear bridge between molecular design and circular-economy applications: by tuning framework architecture, pore environment, and binding sites, COFs can evolve from elegant model materials into practical platforms for selective recovery of critical and precious metals from waste streams. The talk will emphasize how this chemistry opens a credible path toward sustainable materials processing, urban mining, and the broader deployment of COFs in environmentally relevant technologies.

Biography



Prof. Mohamed Siaj earned his Ph.D. in Chemistry from Laval University in Quebec, Canada, and completed postdoctoral training at Columbia University in New York, USA. From 2008 to 2024, he was a full professor in the Chemistry Department at the Université du Québec à Montréal (UQAM). Since 2024, he joined Sherbrooke University, department of chemical engineering as a full professor and holds a Tier-1 Canada Research Chair in Electroactive Materials for Energy Harvesting and Sensors (2024–2031), following his previous Tier-2 Chair in Functional Electroactive 2D-Materials for Bio and Chemical Sensing (2016–2024). Since 2017, Prof. Siaj has directed the institutional Nanomaterials and Energy Research Center (NanoQAM). In 2023, he starts leading the Quebec Centre for Advanced Materials (QCAM), an FRQNT-funded strategic cluster that connects over 12 university and college research groups. Since 2025 he is leading the Research Centre for Green Materials and Processes (CEMAPROVUS) at the University of Sherbrooke. Prof. Siaj's group is a leading authority in the synthesis of high-purity 2D and 3D functional materials, driving major advances in cutting-edge materials design and applications.