Notka biograficzna:

Prof. Mohamed Mehdi Chehimi jest Dyrektorem Naukowym w Centre National de la Recherche Scientifique (CNRS). Jego główne zainteresowania naukowe to chemia powierzchni i analiza powierzchni XPS materiałów reaktywnych i funkcjonalnych. W szczególności interesuje się opracowywaniem cienkich warstw i nanokompozytów polimerowych oraz soli diazoniowych. Niedawno rozpoczął nowy projekt badawczy dotyczący produkcji materiałów na bazie biowęgla i jego zastosowań w leczeniu chorób tropikalnych. Prof. Chehimi jest autorem blisko 400 artykułów naukowych, ponad 25 rozdziałów w książkach i 3 patentów, a także był redaktorem sześciu książek. Jego prace były cytowane ponad 19 000 razy (indeks H = 73). Prof. Chehimi zajmuje miejsce na liście 2% najlepszych naukowców na świecie według Uniwersytetu Stanforda.

Tytuł wykładu:

ENGINEERED BIOCHAR: THE NEW BLACK GOLD FOR SUSTAINABLE DEVELOPMENT

Biochar is a porous carbon allotrope produced through the thermochemical conversion of biomass (e.g., agrowastes, manure, leather waste) under inert or oxygen-limited atmosphere, typically within the temperature range of 300-1000 °C. In recent years, biochar has attracted significant attention within the "Waste-to-Wealth" paradigm, as it enables the valorization of low-value feedstocks into high-value functional materials. Indeed, high-added-value materials can be obtained from biochar, such as pollutant adsorbents, supports for nanocatalysts, porous materials for soil amendment, composite materials for combating pathogenic microorganisms, and energy storage, to name a few. For this versatility, biochar has been coined "New Black Gold". The physicochemical properties of biochar (composition, pore structure, and surface functionality) are strongly influenced by the type of precursor biomass as well as pyrolysis parameters. Further tunability can be achieved through post-synthetic modifications, including wet impregnation, heteroatom doping, and incorporation of nanomaterials within its porous matrix. Herein, we will summarize our research on biochar-based functional materials obtained from a large set of agro-wastes such as olive stones, date palm wastes, sugarcane bagasse, walnut and peanut shells, millet, marine algae, rose petals, and brewer spent grains.

We highlight strategies for tailoring porosity through maceration, grinding, pre-hydrothermal treatment, and wet impregnation. Notably, we demonstrate that wet impregnation can reduce the pyrolysis activation energy, thereby enabling maximum weight loss at lower conversion temperatures [1]. Additional pore engineering could also be achieved via "green" activation methods. The potential applications of these engineered biochars are diverse. We discuss the removal of PFAS by pristine porous biochar, and biochar@nanoparticles in Fenton-like reactions of water depollution, detection of lead by amalgamation with biochar@Ag NPs [2], neglected tropical disease (NTD) treatment, CO2 methanation over biochar@Ni composite catalysts [3], the development of biochar as electrode material and supercapacitors [4], and for innovative, sustainable construction and building strategies.

All in all, our research efforts underscore the potential of biomass-derived biochar as a versatile platform for advanced functional materials. By transforming agricultural and industrial wastes into reactive, value-added products, we contribute to the United Nations' Sustainable Development Goals (SDG). Notably, this includes SDG3 (Good Health and Well-Being), SDG6 (Clean water and Sanitation), SDG7 (Affordable and Clean Energy), and SDG11 (Sustainable Cities and Communities), thereby aligning with the concept of "Waste-to-Wealth".

References:

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[2] Lo et al. Electrochim. Acta, 2025, https://doi.org/10.1016/j.electacta.2025.147214
[3] Gamal et al., Mater. Today Sustain., 2024, https://doi.org/10.1016/j.mtsust.2023.100627
[4] Diop et al. Surfaces, 2025, https://doi.org/10.3390/surfaces8040087