Advancing global sustainable technologies through the unified conversion of biomass and plastics by heterogeneous catalysis

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This contribution outlines how the field of green chemistry is pivotal in aligning with global ecological transition goals through its focus on sustainable chemical processes. Green chemistry innovatively employs renewable resources like various lignocellulosic biomasses and repurposes waste materials, including plastics, to develop high-value products sustainably [1-3]. This transformative research field leverages the structural similarities between biomass and plastics, particularly their polymer makeup and bond types, which are instrumental in their conversion processes.

Recent advancements have seen the development of intersecting conversion pathways for biomass and plastics, influenced by their shared chemical structures. A 'unified view' of the chemical principles that govern these processes, illustrating how understanding the cleavage of C-C and C-O bonds in lignocellulosic biomass, and similar bond types in polyolefins, advances the upcycling of waste plastics will be presented. Specifically, it will be explored how the knowledge gained from lignocellulose conversion, particularly in cleaving C_{arom}-C and ether bonds, is applicable to the production of aromatic compounds from plastics.

Furthermore, the contribution discusses innovative strategies like reductive-assisted depolymerization for overcoming the challenges posed by inert C_{aliph}-C bonds in polyolefins, thereby opening new pathways for biomass transformation. The discussion extends to the significant scientific challenges that have been addressed and those that remain underexplored in bridging the gap between theoretical and practical applications of green chemistry.

By focusing on the fundamental chemistry behind these transformations, this contribution aims to highlight how chemical knowledge is crucial in driving technological innovations that contribute to a sustainable future. Through this approach, this contribution underscores the potential for fundamental science to catalyze significant advancements in green chemistry, thereby supporting broader environmental and sustainability goals on a worldwide scale.

References

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BIO

Prof. Dr. Francesco Mauriello received his Ph.D. in Industrial Chemistry in 2008 from the University of Bologna, Italy. Following his doctoral studies, he undertook postdoctoral research at Politecnico di Torino from March 2008 to February 2010 and later at the Mediterranea University of Reggio Calabria from March 2010 to November 2011. Since January 2022, he has been serving as an Associate Professor at the Mediterranea University of Reggio Calabria, Italy, focusing on the valorization of biomass and waste into value-added materials, fuels, and chemicals. Prof. Mauriello's professional journey includes multiple international academic positions. He has served as a Visiting Assistant Professor at several prestigious institutions, including the Catalysis Research Center at Hokkaido University in Japan and the CAT Catalytic Center at Aachen University in Germany. As of May 2024, his scientific contributions include 52 articles, 8 reviews, and numerous conference papers and book chapters, leading to a significant citation count and an H-index of 24. His current research projects focus on green chemistry for the circular economy and catalytic upcycling of polyolefin waste, supported by substantial funding from national and regional sources. He is an active member of several national and international chemical societies and committees and from January 2021 is in the national board member of the Interdivisional Group of Catalysis (GIC) of the Italian Chemical Society (SCI).