Water-Driven Organic Syntheses Using Recyclable Nanocatalysts: Efficient Routes to Diaryl Ethers, Aryl Ketones, and Triazoles

Ali Shiri

Department of Chemistry, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran.

E-mail: alishiri@um.ac.ir

This study highlights innovative approaches utilizing water as a green solvent in catalytic systems for sustainable organic transformations. Two heterogenous magnetic nanocatalysts, Fe_3O_4@Starch-Au and Fe_3O_4@HKUST-1 as well as one metal-organic framework (MOF) nanocatalyst, UIO-66/Sal-$ZnCl_2$, were developed. Characterization of the nanoparticles using FT-IR, XRD, SEM, TEM, EDS, VSM, and ICP techniques confirmed successful coating and stability. Diverse organic reactions were studied under the optimized conditions: Ullmann-type O-arylation of phenols and aryl tosylates to diaryl ethers,(1) hydration of terminal alkynes and nitriles to aryl ketones and amides,(2) azide-alkyne cycloaddition for 1,2,3-triazoles (3) and one-pot, three-component click reaction involving terminal alkynes, alkyl halides, and sodium azide to prepare 1,2,3-triazole heterocycles.(4) All systems emphasized water as a solvent, eliminating toxic reagents, organic solvents, and harsh conditions. The catalysts exhibited high efficiency, regioselectivity, magnetic recoverability, and underscoring their roles in eco-friendly protocols. These studies advance green chemistry by integrating aqueous media, recyclable nanocatalysts, and energy-efficient methodologies for scalable and environmentally benign synthesis.

REFERENCES

1) S. A. Mousavi-Mashhadi, A. Shiri, On-Water and Efficient Ullmann-Type O-Arylation Cross-Coupling Reaction of Phenols and Aryl Tosylates in the Presence of Fe_3O_4@Starch-Au as Nanocatalyst, *ChemistrySelect*, **2021**, 6, 3941-3951.
2) S. A. Mousavi-Mashhadi, A. Shiri, Catalytic Hydration of Terminal Alkynes and Nitriles Without Reducing Reagents, Acidic Promoters, and Organic Solvent over Fe_3O_4@Starch-Au, *J. Iran. Chem. Soc.*, **2022**, 19, 4523.

3) E. Arefi, A. Khojastehnezhad, A. Shiri, A Magnetic Copper Organic Framework Material as An Efficient and Recyclable Catalyst for The Synthesis of 1,2,3-Triazole Derivatives, *Scientific Reports*, **2021**, 11, 20514.
4) M. Rezaie, A. Khojastehnezhad, A. Shiri, Post-Synthetic Modification of Zr-Based Metal-Organic Framework by Schiff Base Zinc Complex for Catalytic Applications in A Click Reaction, *Scientific Reports,* **2024**, 14, 24644.