



## Multifunctional Bimetallic MOFs/ZIFs for Air and Water Purification: Optimization of Water-Based Mechanochemical-Assisted Green Synthesis

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The increasing complexity of environmental pollutions demands the development of advanced multifunctional materials capable of adsorb, degrading, and neutralization of air and water pollutants. Novel nanomaterials are essential for effectively addressing these challenges [1].

Nowadays, Metal-Organic Frameworks (MOFs) showed high interest regarding their high adsorptive and catalytic performance on air and water purification. Their easy synthesis, chemical and thermal stability, tunability, and high surface area. However, issues such as structural instability when water is present, high synthesis costs, and limited regeneration efficiency continue to challenged the practical application of MOFs [2].

Chemical Warfare Agents (CWAs) introduced to the world during the World War I. Mustard gas or bis(2-chloroethyl) sulfide (HD) was the most abundant CWA and referred as the “King of Battle Gases”, breached through regular textiles, causing skin burns, blindness, nervous system failure, and even death [3]. Since, HD high toxicity, 2-chloroethyl ethyl sulfide (CEES) was used for lab purposes. Diclofenac (DICL) is referred as a compound of the utmost importance, regarding water purification, since is prescribed as a pain relief medication and reported as one of the most frequently pharmaceutical in wastewater treatment plant effluents [4].

In this work, we optimized the synthesis of bimetallic Co/Zn Zeolitic Imidazolate Frameworks/ZIFs (ZIF-678) nanoparticles taking place using water as a solvent. The impact of ultrasound-assistance and/or magnetic stirring were examined during the selection of the appropriate synthesis method. We evaluate both mono- and bi-metallic ZIF powders against organic contaminants simulants in water and air. Diclofenac sodium salt was used as model water pollutant, while CEES represents a major airborne threat. ZIF powders exhibited high multifunctional detoxification efficiency, combining adsorptive capture and catalytic degradation to effectively neutralize CEES vapors, while the co-presence of Co and Zn significantly enhanced catalytic activity. In addition, the materials demonstrated efficient removal of DICL from aqueous media, highlighting their versatility across gas- and water-phase contaminants. The antibacterial performance of the powders was also evaluated, revealing that Co incorporation markedly improved the inactivation of *E. coli* cells.

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### References

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