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Utilization of MOF in Clean Environment Purposes

Sk. Tanjim Jaman Supto[1], Md. Nurjaman Ridoy[1] , Md. Golam Sazid[1]

Department of Environmental Research, Nano Research Centre, Sylhet, 3114, Bangladesh[1]

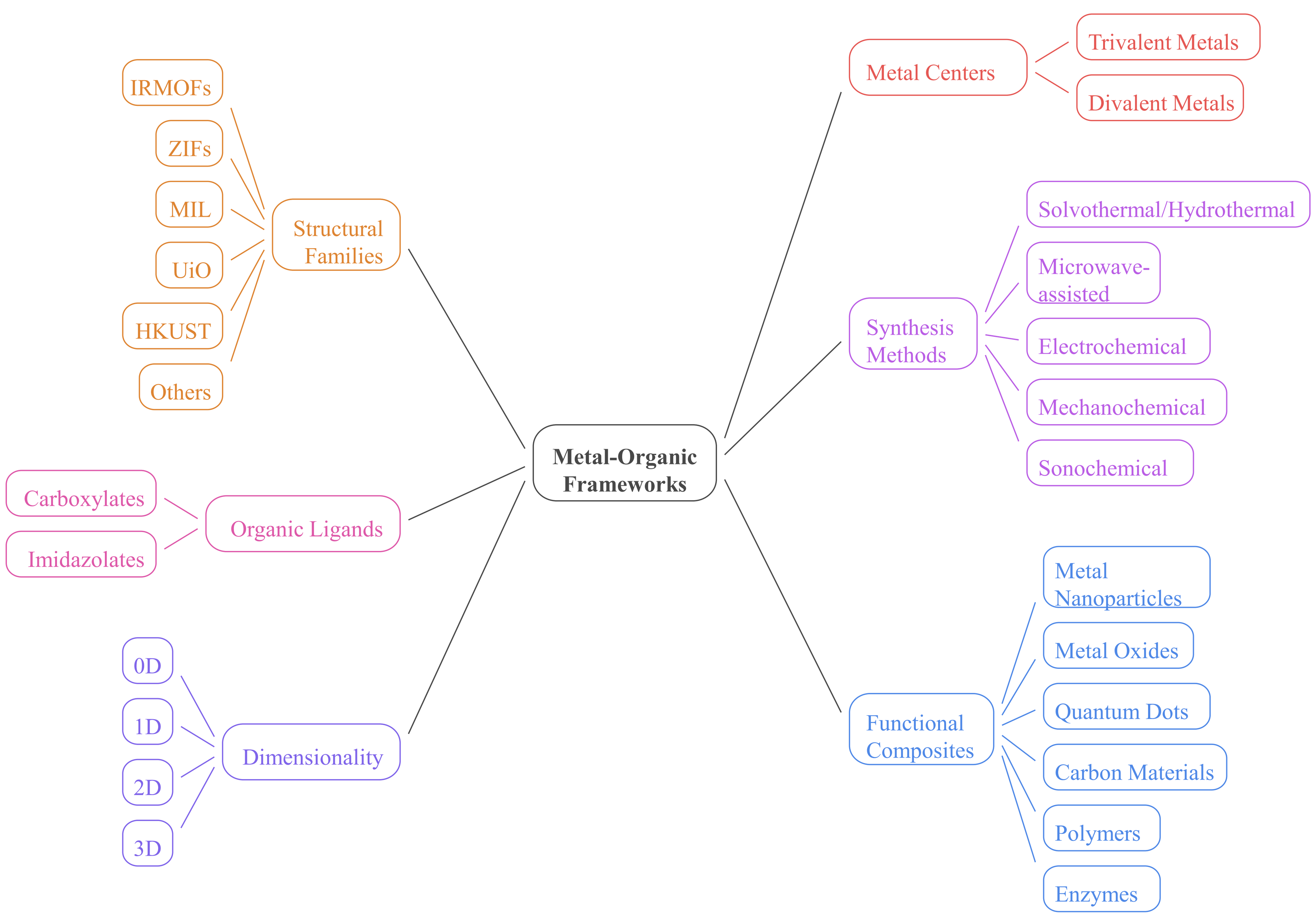
*Corresponding author email: sksupto7@gmail.com

ABSTRACT

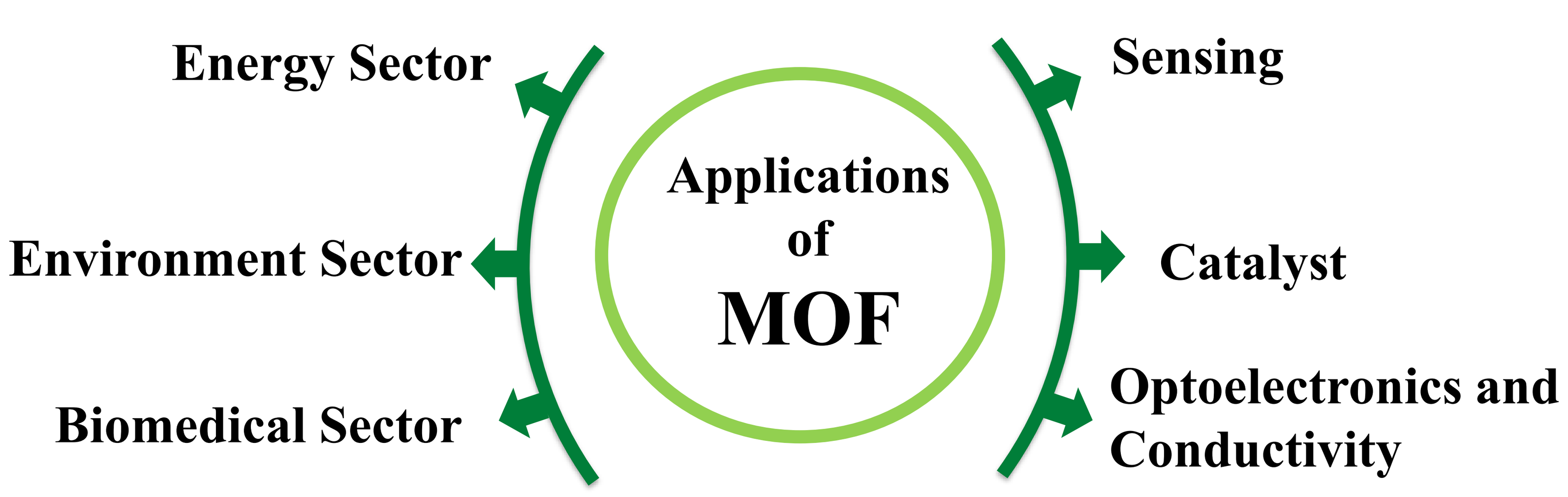
Metal-Organic Frameworks (**MOFs**) and their various nanocomposites have emerged as powerful tools for environmental protection, particularly in water purification, air quality improvement, and pollutant degradation. These materials demonstrate exceptional adsorption capabilities for pharmaceuticals, pesticides, and dyes in wastewater treatment, as well as volatile organic compounds (**VOCs**) and toxic gases in air purification. Our research specifically focuses on the application of **Zn-MOF** composites for wastewater remediation, investigating their adsorption efficiency and photocatalytic performance in removing hazardous contaminants. Through adsorption experiments and spectroscopic analysis, it was observed that **Zn-MOF** composites achieved a high removal efficiency for lead (**Pb(II)**) ions and for cadmium (**Cd(II)**) from industrial wastewater, outperforming conventional adsorbents. Additionally, **ZIF-67** exhibited high efficiency in microplastic removal, and **Ag@ZIF-8** composites demonstrated enhanced antibacterial activity against **E. coli and S. aureus**, making them ideal for water disinfection applications. Further, **UiO-66** was effective in adsorbing organic pollutants and heavy metals, confirming its potential in large-scale wastewater treatment. Beyond water treatment, our study also explores **MIL-101** for toxic gas sequestration, particularly **CO_2** and **SO_2** capture, contributing to industrial air purification efforts. These findings underscore the versatility and efficiency of **MOF**-based nanomaterials in environmental remediation, paving the way for scalable and sustainable solutions. While challenges remain in terms of cost-effectiveness and long-term stability, continued research on **MOF** optimization and functionalization will enhance their applicability in real world environmental challenges

STRUCTURAL CHARACTERISTICS OF MOFs

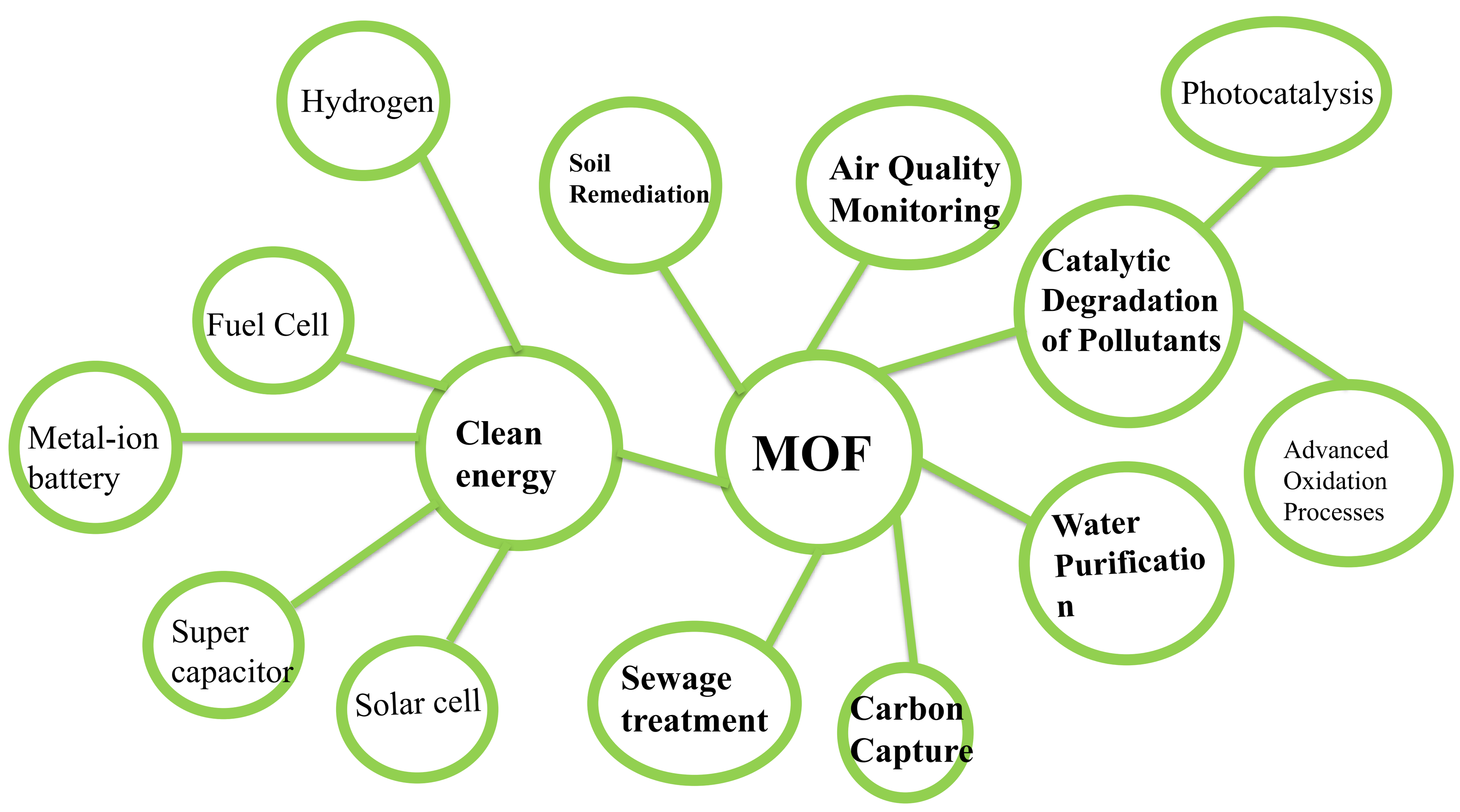
TYPES OF MOFs



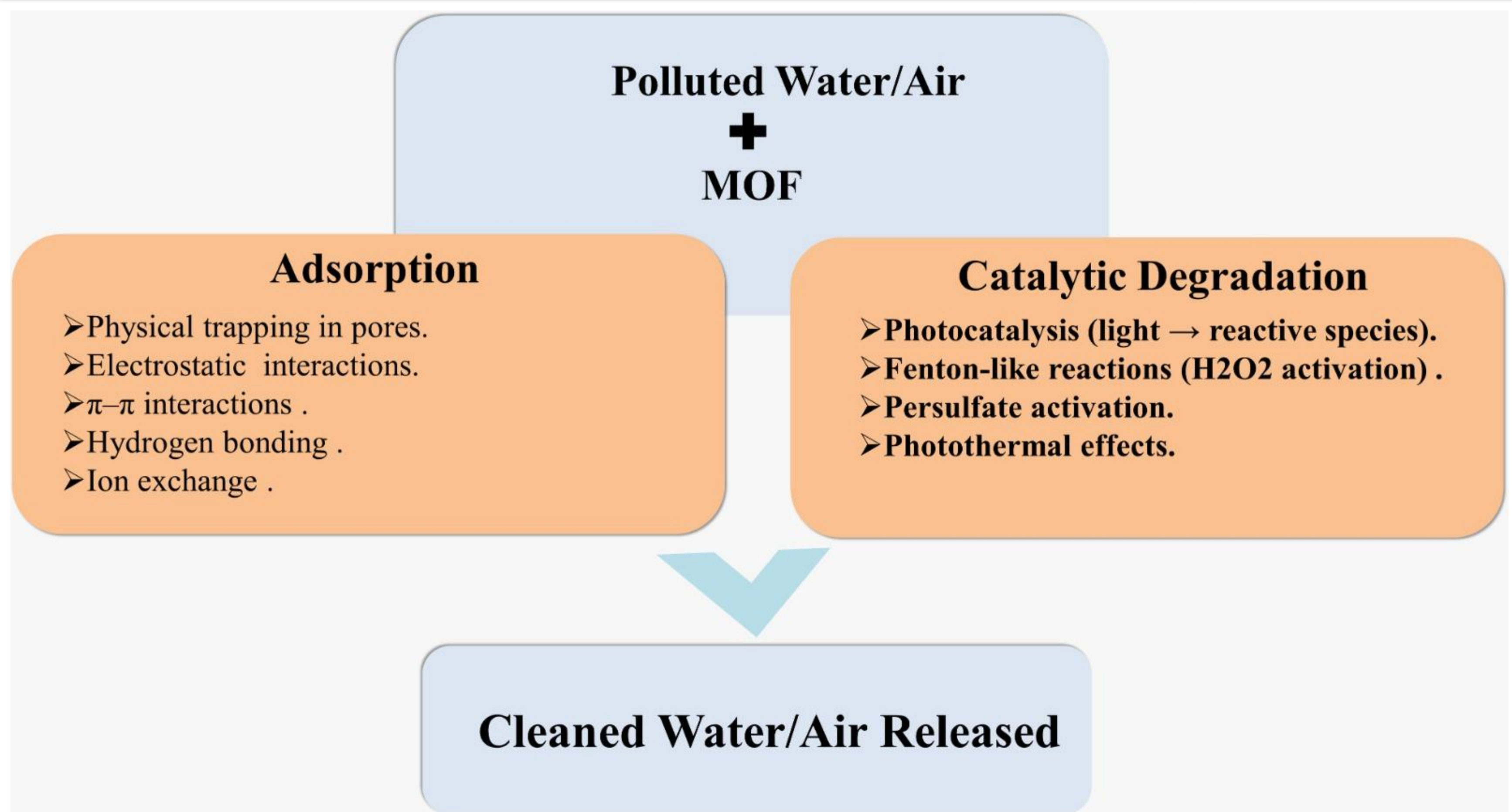
APPLICATIONS OF MOFs



MOFs IN SUSTAINABLE ENERGY ENVIRONMENTAL REMEDIATION



APPLICATION OF MOFs IN POLLUTANT REMOVAL



CHALLENGES AND FUTURE PROSPECTS OF MOFs IN CLEAN ENVIRONMENTAL APPLICATIONS

Metal-Organic Frameworks (MOFs) offer immense potential for clean environmental technologies, from pollutant removal to sustainable energy systems. Yet, their large-scale use faces key challenges such as high production costs, synthesis complexity, and stability under real world conditions. Some **MOFs** also pose environmental risks due to toxic components. However, the future is promising: advances in AI-guided material design, green synthesis methods, and structural tuning (like defect engineering) are expanding **MOFs**' performance and safety. With continued innovation, **MOFs** are poised to become vital tools in achieving long-term environmental sustainability.

CONCLUSION

MOFs and their nanocomposites offer a highly effective and adaptable platform for clean environmental solutions, particularly in water purification, air detoxification, and pollutant capture. Their proven efficiency in removing heavy metals, microplastics, and toxic gases highlights their transformative role in sustainable environmental technologies. With ongoing innovation, **MOFs** are set to become key materials in addressing global pollution challenges.

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