Green Synthesis and Characterization of Silver Nanoparticle decorated Urea-Based Metal-Organic Frameworks (Ag NPs@TMU-MOFs) for the Carboxylation of Terminal Alkynes using CO_2

Armaghan Khosravi, Stefania Impellizzeri*

Laboratory for Nanomaterials and Molecular Plasmonics, Department of Chemistry and Biology, Toronto Metropolitan University, Toronto, ON M5B 2K3, Canada

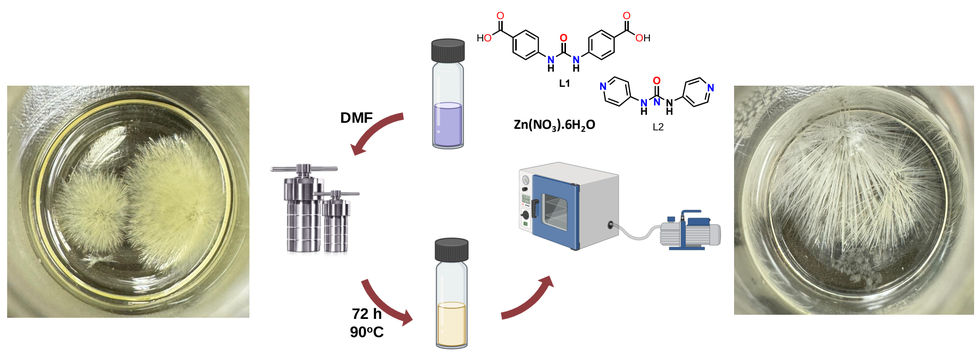
akhosravi@torontomu.ca simpellizzeri@torontomu.ca

MOF2024 9th International Conference on Metal-Organic Frameworks and Open Framework Compounds

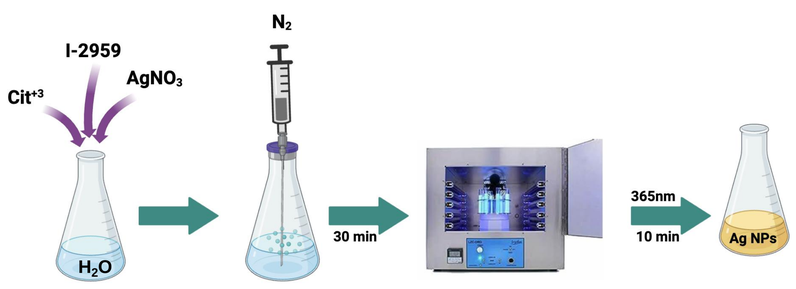
Background & Rationale

Silver nanoparticles (Ag NPs) are well known for their exceptional antimicrobial properties, high electrical conductivity, and catalytic activities. These properties make them valuable in various applications, including medical devices, electronics, and catalysis. Meanwhile, metal-organic frameworks are porous crystalline materials containing metal ions or clusters and organic molecules. Their high surface areas, tunable pores, and versatile chemical functions make them ideal for gas storage, separation, catalysis, and drug delivery. By incorporating Ag NPs into the MOF structure, the resulting Ag NPs@MOF nanocomposite utilizes the advantages of both materials. By protecting and stabilizing the Ag NPs, the MOF matrix prevents agglomeration and enhances dispersion. In addition to preserving silver nanoparticle intrinsic properties, this integration also offers improved properties, such as recyclability and enhanced antimicrobial and catalytic performance. Furthermore, this approach aligns with green chemistry principles by reducing waste through catalyst reuse and minimizing hazardous solvents. The integration of Ag NPs within MOFs provides an environmentally friendly method for developing high-performance materials, contributing to sustainable solutions in catalysis and antimicrobial applications.

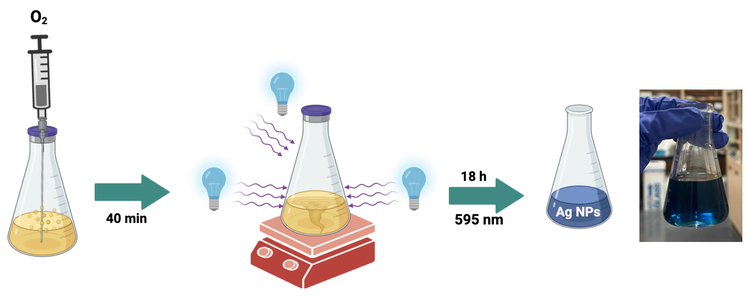
Materials Synthesis



Synthesis of TMU-MOFs



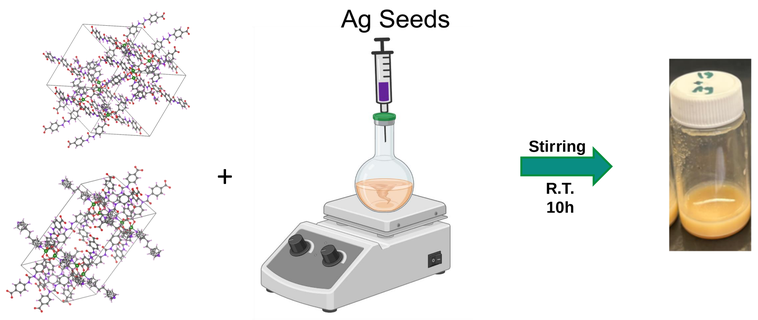
Synthesis of Ag Seeds



Synthesis of Ag Nanoplates

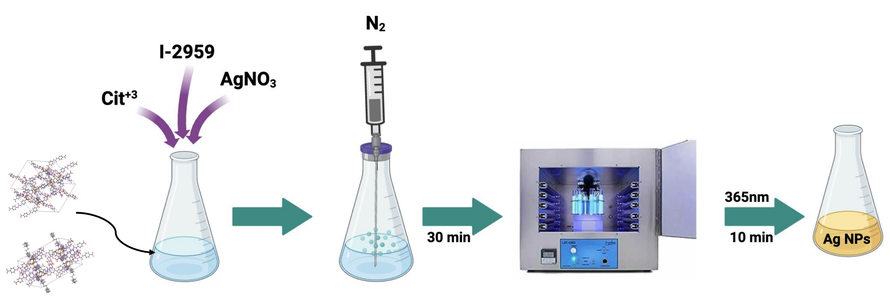
Nanocomposites Synthesis

Method 1



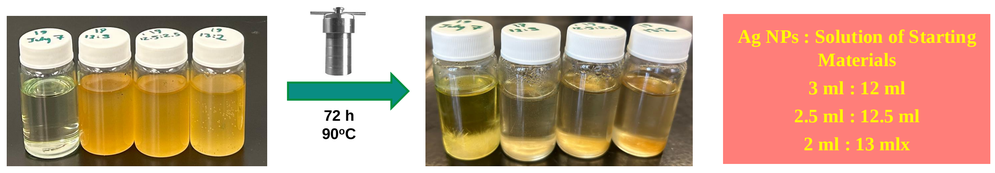
Synthesis of Ag Seeds@TMU-MOFs (Mixing)

Method 2



Synthesis of Ag Seeds@TMU-MOFs (in the presence of MOF)

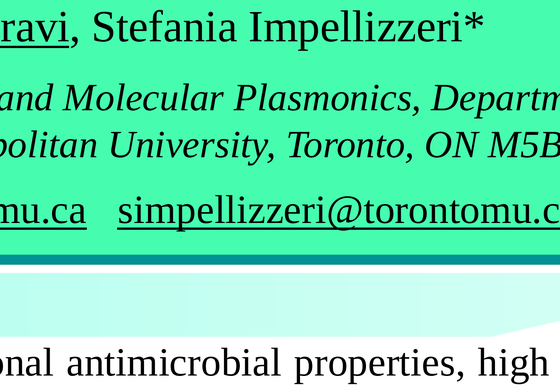
Method 3

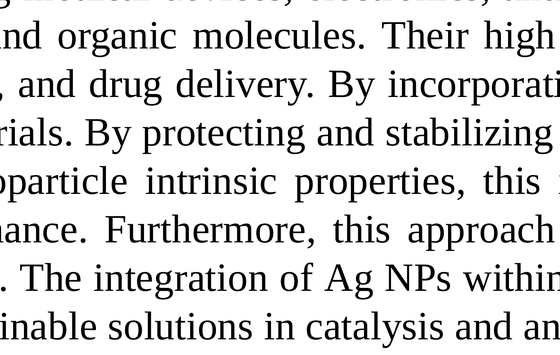


Ag NPs : Solution of Starting Materials
3 ml : 12 ml
2.5 ml : 12.5 ml
2 ml : 13 mlx

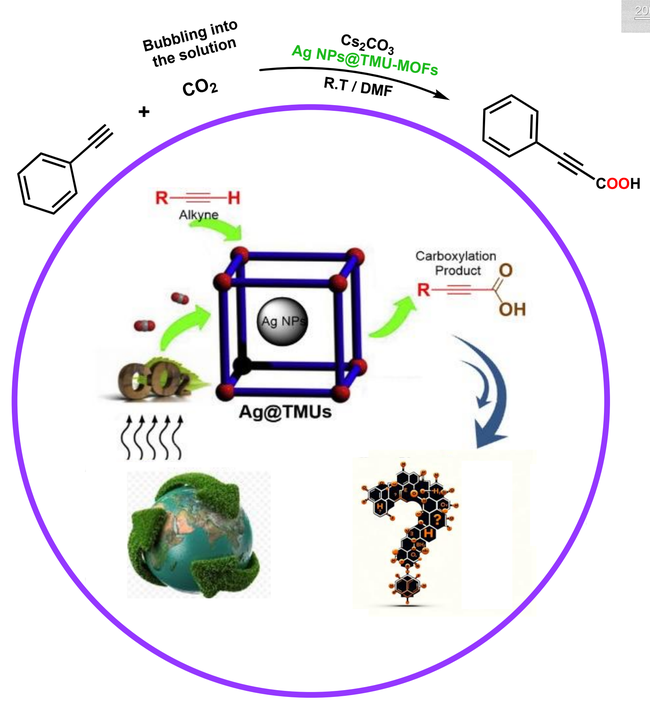
Synthesis of Ag NPs@TMU-MOFs (in the presence of Ag NPs)

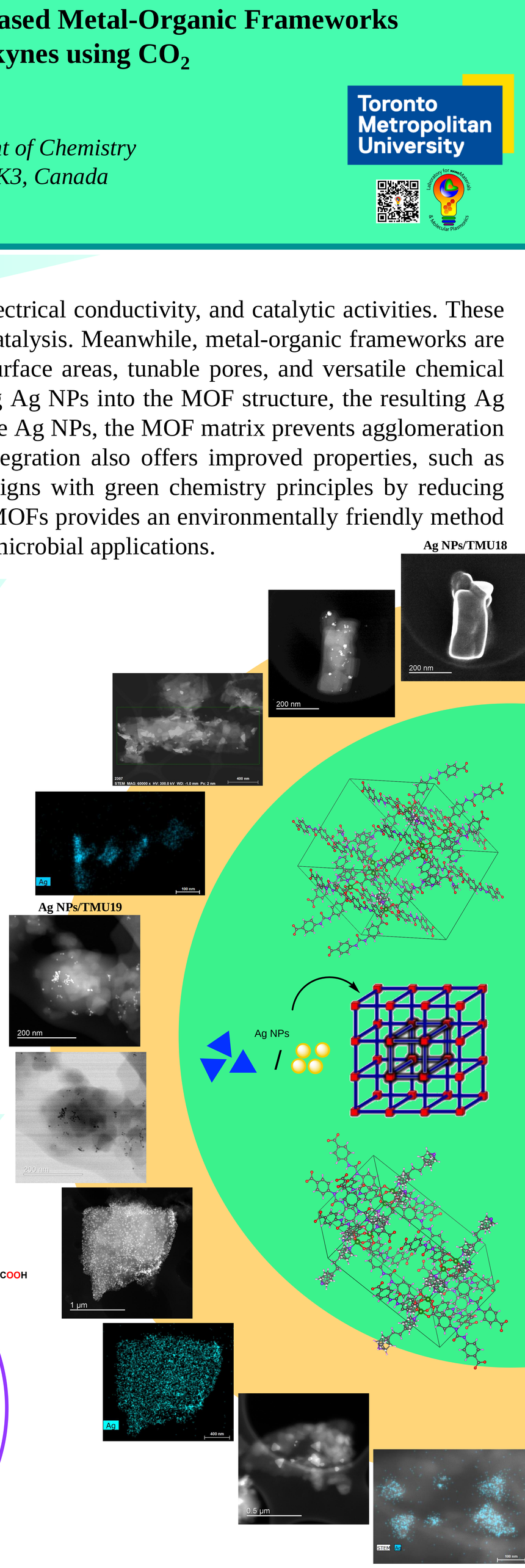
Absorption Spectrum





Application





Future Study

- Developing a green synthesis method for TMU-MOFs.
- Performing X-ray photoelectron spectroscopy (XPS) and surface area analyzer (BET), and Inductively Coupled Plasma Spectroscopy (ICP)
- Catalytic study

References

- Tehrani et al. Chem. A. 2015, 3(40), 20408.
- Azhdari Tehrani A et al. Inorg. Chem. 2017, 56(3), 1446.
- Dogantzis N.P et al. Nanoscale Adv. 2020, 2(5), pp.1956.
- Tahmasebi S et al. J. Organomet. Chem. 2017, 853, 35-41.

Acknowledgments

Dr. Stefania Impellizzeri
Dr. Pedro Ortiz
Dr. Ryan Hutchins
Sumaiya Afrin Soha
Emmanuel Fagbohun
Ose Ibazebo
Ishpreet Chana
Armaan Goraya

Toronto Metropolitan University
NSERC CRSNG
Department of Chemistry and Biology
Ontario