



Photocatalytic degradation of tetracycline in water using Bi₂CuO₄

Mpho Tsotetsi^{1*}, Collette Khabo-Mmekoa², Mpho Lekgoathi³, Mabuatsela Maphoru¹

¹Department of Chemistry, Tshwane University of Technology, Private Bag X680, Arcadia Campus, Pretoria 0001, South Africa, E-mail: 221023544@tut4life.ac.za.

²Department of Microbiology, Tshwane University of Technology, Private Bag X680, Arcadia Campus, Pretoria 0001, South Africa.

³The South African Nuclear Energy Corporation (Necsa), R104 Pelindaba, Madibeng Municipality, North West Province, 0240, South Africa.

INTRODUCTION

Pharmaceuticals like antibiotics are a growing concern in wastewater and water bodies such as groundwater, seawater, rivers, lakes, and even drinking water [1]. Long-term exposure to these substances poses risks to human health, plant life, and marine ecosystems due to their toxicity. Traditional methods, used in many wastewater treatment plants such as coagulation and membrane filtration, are often ineffective at removing or degrading antibiotic pollutants, allowing these contaminants to spread in the environment at low levels [3]. Photocatalysis has emerged as an advanced oxidation process for removing antibiotics from water by generating reactive oxygen species such as superoxide anions (O₂⁻), hydroxyl radicals (•OH), and peroxy radicals (•OOH) in the presence of light [4]. These reactive species can break down complex organic compounds like antibiotics into simple and non-toxic substances such as carbon dioxide and water [4]. One example of photocatalysts, bismuth copper oxide (Bi₂CuO₄) has a narrow bandgap of 1.5 eV – 2.0 eV, which enable the semiconductor to absorb visible light [5]. Copper doping in Bi₂CuO₄ introduces impurity, which is expected to reduce the electron hole recombination rate, improve oxidation capability and enhance photocatalytic activity [6]. Bi₂CuO₄ was synthesised using hydrothermal analysis and its characteristics were explored using techniques such as XRD and SEM.

AIMS & OBJECTIVES

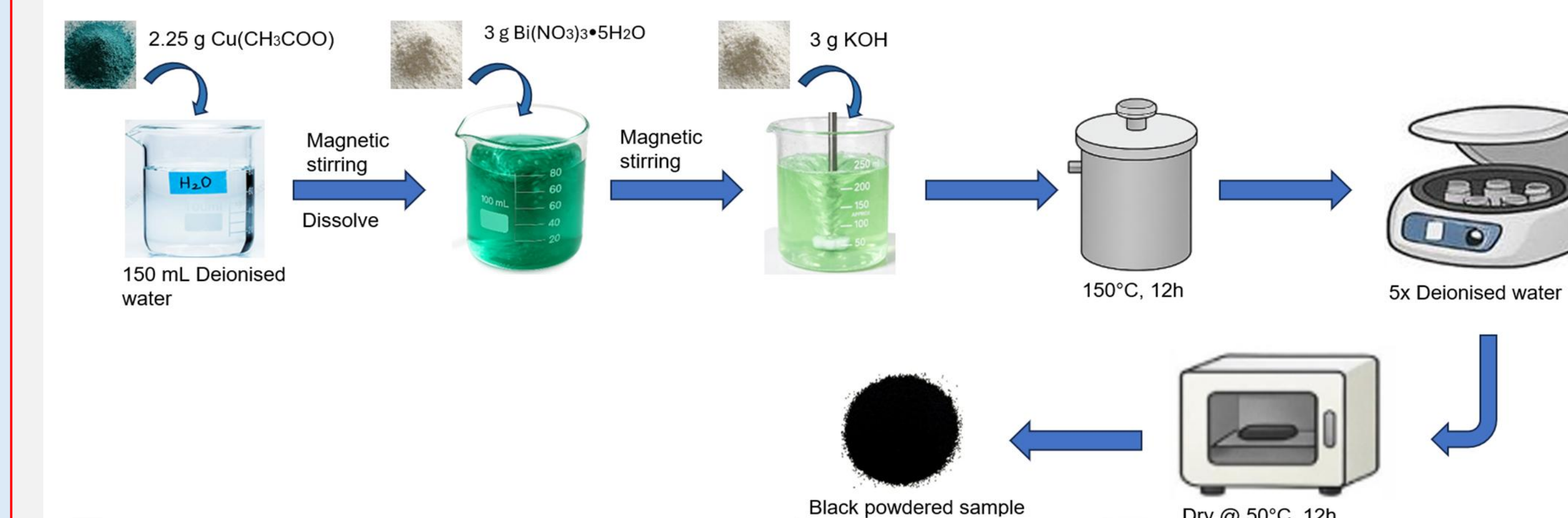
• Aim

The aim is to synthesis Bi₂CuO₄ using hydrothermal reaction, then test for its photocatalytic degradation of tetracycline antibiotics under visible and ultraviolet light.

• Objectives

- Synthesis of Bi₂CuO₄ using hydrothermal reaction
- Determine its physicochemical and electronic properties using spectroscopic analysis and optoelectronic characterisation techniques.
- Assess their photocatalytic degradation against tetracycline in water .

MATERIAL SYNTHESIS



RESULTS

XRD

XRD pattern for Bi₂CuO₄ contains diffraction peaks at 2θ of 22.8°, 25°, 28.7°, 31.6°, 34.1°, 36.3°, 39.8°, 43.9°, 53.8°, 56°, 59.9°, 64.2°, 75°, 76.3°, and 81.2° that corresponds to (200), (211), (220), (002), (102), (310), (311), (411), (213), (412), (530), (611), (314), (523), and (404) crystal planes tetragonal crystal structure of Bi₂CuO₄

FT-IR

Broad band @3200 cm⁻¹ suggest O-H stretch
sharp peaks @ 1430 cm⁻¹ & 1330 cm⁻¹ suggest Bi-O stretch
Peak @ 1040 cm⁻¹ suggest Bi-O & Cu-O stretch
Multiple peaks @ 544 cm⁻¹-1040 cm⁻¹ suggests Cu-O stretch

SEM & EDX

SEM image shows rods agglomerated together with EDX showing the elements such as Bi, Cu, O, C & K, which are the elements expected in Bi₂CuO₄

CATALYST TESTING

Bi₂CuO₄ achieved 62.07% of tetracycline using 450 W ultraviolet light

Bi₂CuO₄ achieved 30% of tetracycline using 450 W visible light radiation

CONCLUSION

Bi₂CuO₄ was successfully synthesised using hydrothermal analysis and characterised through XRD, FT-IR, & SEM.

The compound Bi₂CuO₄ was effective in degrading tetracycline. Under UV light, the degradation was enhanced to 62.07%. While under visible light, the degradation was 30%.

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XRD & FT-IR

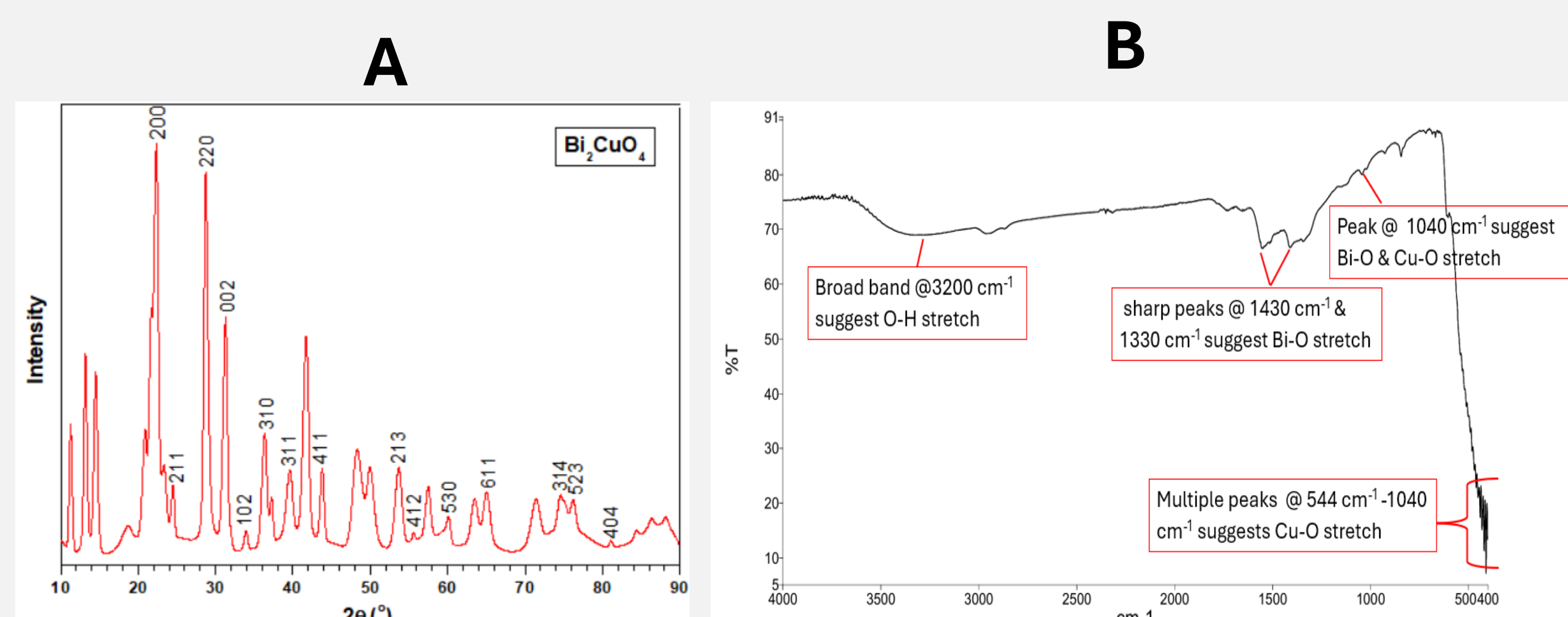


Figure 1: A) XRD patterns, B) FT-IR spectra of Bi₂CuO₄

SEM

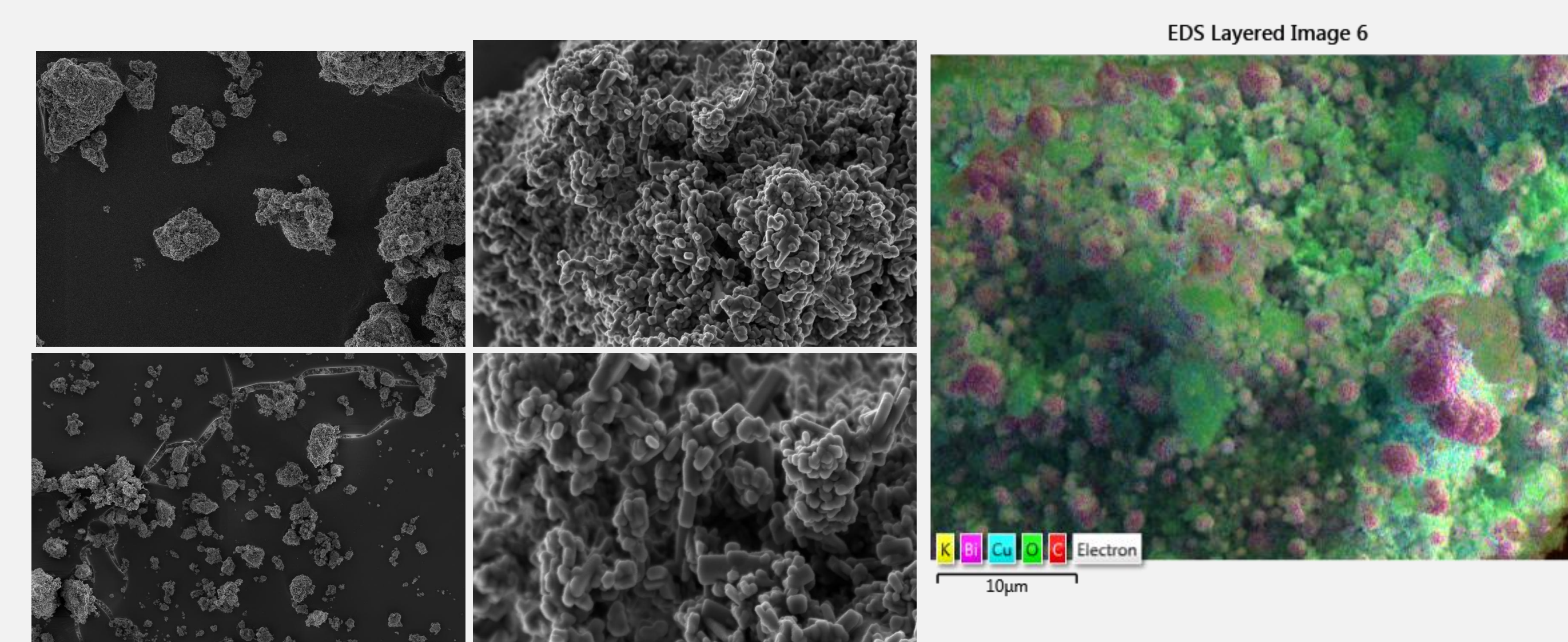
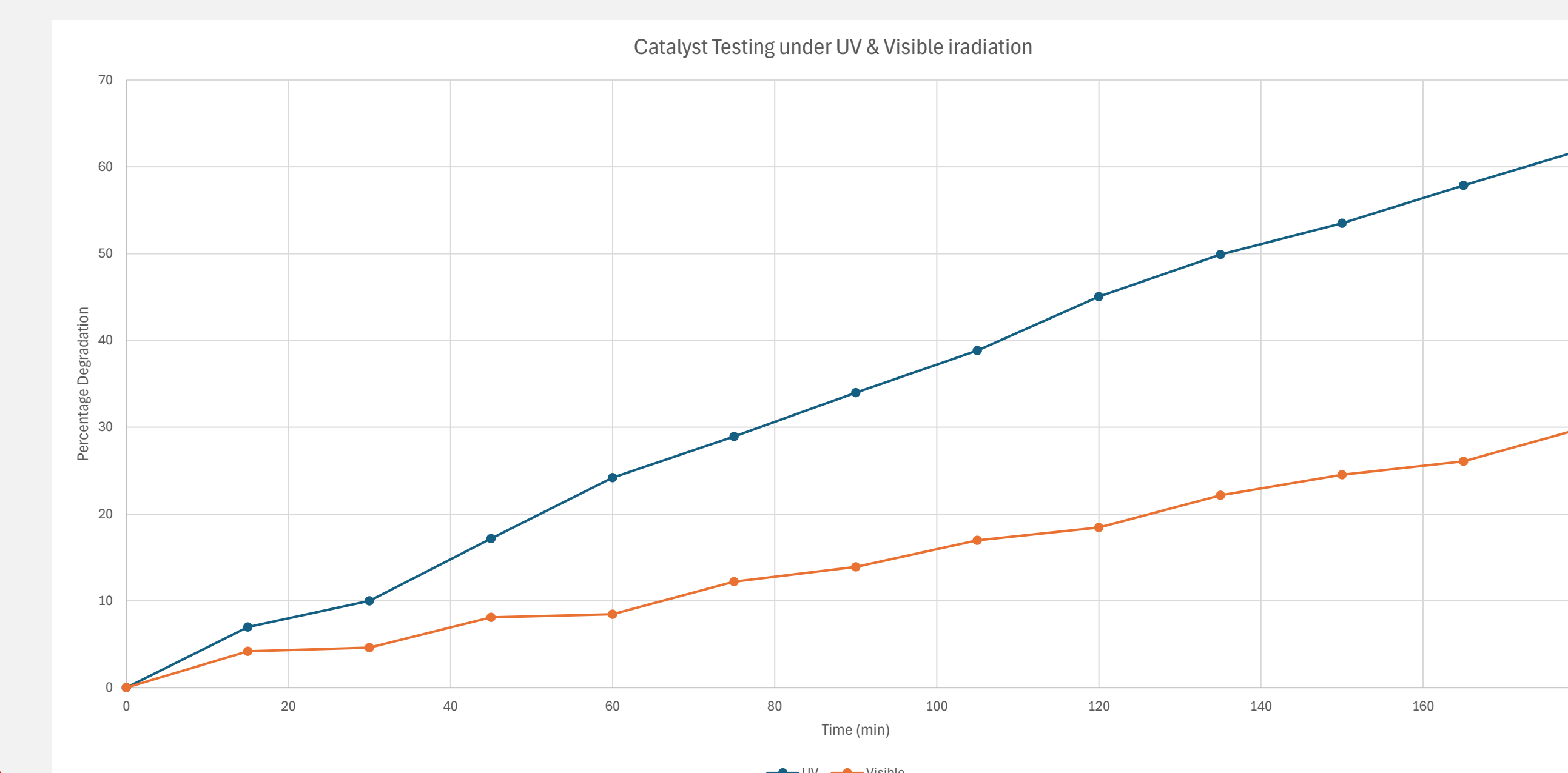


Figure 2: SEM image and EDX for Bi₂CuO₄

CATALYST TESTING



ACKNOWLEDGMENTS