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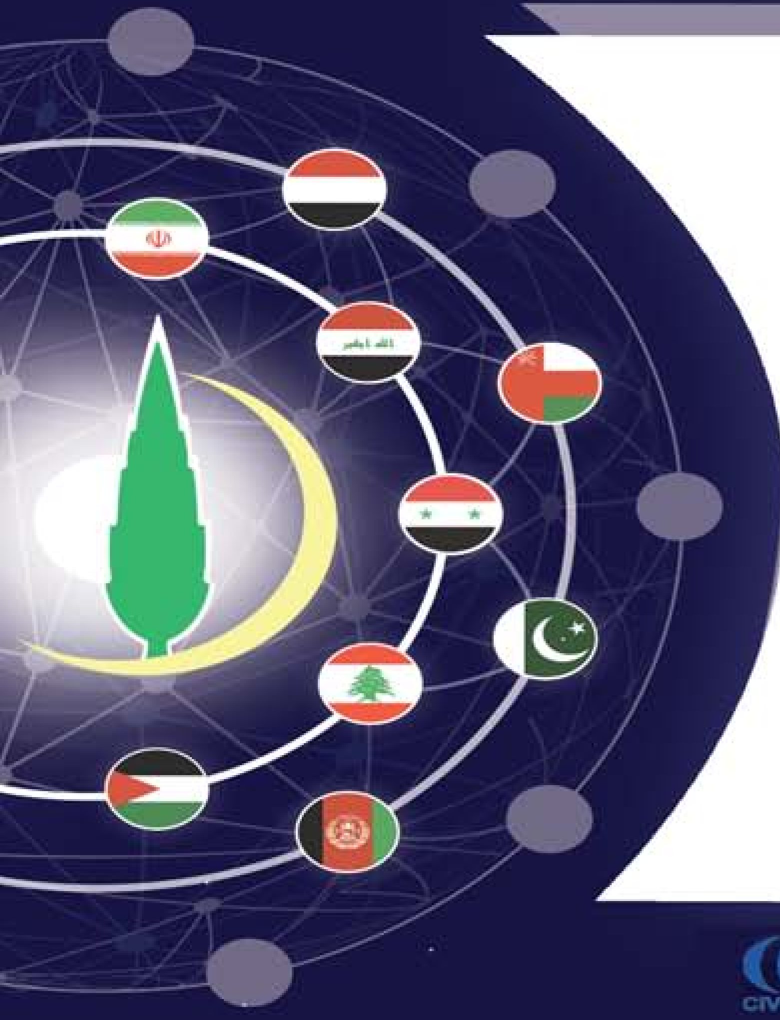

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Tuning surface structure of BiOI photocatalysts using magnetized methanol: Applied magnetic field

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Abstract— Magnetic fields have been extensively used for the synthesis of nanostructures. In this study, a magnetic field was applied to methanol, named magnetized methanol, to be utilized as a solvent in the solvothermal synthesis of bismuth oxyiodide (BiOI) photocatalysts. The primary goal of this research is to present a novel technology for modifying nanostructures to enhance their applications.

Keywords: Magnetized methanol, Nanostructures, BiOI, Morphology control

1. INTRODUCTION

Among bismuth oxyhalides, BiOI has been recognized as semiconductors with a two-dimensional layered structure, featuring a narrow band gap and activation under visible light [1]. Modifying synthesis conditions can alter the crystal structures and morphologies leading to the utilization of their anisotropic properties in different plane orientations [2]. Arumugam et al. identified different BiOI morphologies, such as 2D square-like nanosheets and 3D hierarchical flower-like structures, which are obtained by altering the solvents (water, ethanol, methanol, and ethylene glycol) during solvothermal synthesis [3].

The effect of magnetic fields on solvent molecule clusters has always been a serious challenge in industry and academia [4]. The physical and chemical properties of the solvent, such as viscosity, zeta potential, and hydrogen bonding, were changed under this modification [5]. Rashidi et al. used ordinary and magnetized ethanol as a solvent to synthesize various zinc oxide (ZnO) structures under the solvothermal method [6].

The main purpose of this research is to create tunable bismuth oxyiodide structures by varying the duration of magnetic field exposure on methanol as a novel solvent to control morphology.

2. METHODOLOGY

A solvent-magnetizing device was applied to magnetize methanol [7]. The magnetic field exposure time was controlled in a closed cycle from 1 pass to 60 min (Fig. 1).

The primary synthesis of BiOI photocatalysts followed the solvothermal method from the literature [3]. The synthesized BiOI photocatalysts were labeled as Bi-X (x: 0, 1 pass, 15, 30, and 60), corresponding to the magnetization time of methanol.

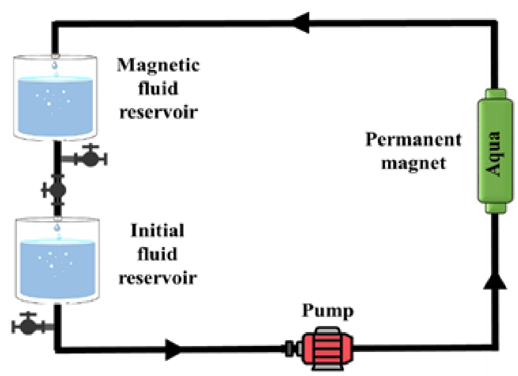

Fig.1 Schematic of Solvent Magnetizing Apparatus (SMA).

3. RESULTS AND DISCUSSION

Fig. 2 illustrates the morphological structure of the synthesized BiOI photocatalysts. The pristine BiOI and Bi- 1 pass displayed numerous irregular 2D nanosheets assembled into 3D flower-like structures (Fig. 2 (a, b) to (c, d)). In contrast, Fig. 2 (e, f) depicted Bi-15 formed regular 3D flower-like microsphere structures [3]. The development of the nanoflower structure from Bi-0 to Bi-30 highlights the impact of magnetic field exposure time on the morphology of methanol-treated BiOI (Fig. 2 (a, b) to (g, h)). Finally, the nanoflake structures of Bi-60 are shown in Fig. 2 (i, j). This indicates that magnetized methanol significantly influences the synthesis process and structural arrangement.

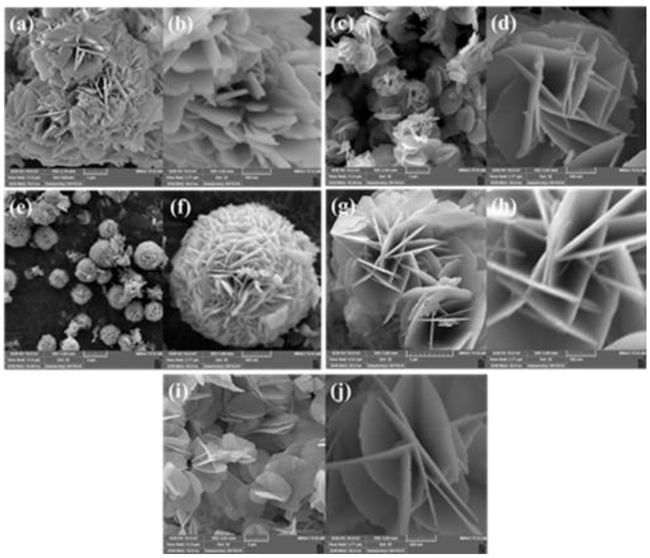

Fig.2 FESEM images of (a, b) Bi-0, (c, d) Bi-1 pass, (e, f) Bi-15, (g, h) Bi-30, and (i, j) Bi-60 in the 2 μm and 500 nm scales.

4. CONCLUSION

In conclusion, a novel approach utilizing magnetized solvent for the synthesis of bismuth oxyiodide semiconductors was introduced. It was found that adjusting the magnetic field exposure time could yield the desired bismuth oxyiodide structure.

This study has shown that magnetized methanol can affect the crystallinity and morphology of BiOI. Overall, this method provides a sustainable and efficient way for the synthesis of nanostructures, consistent with environmentally friendly practices.

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