

## Tailored Co- and Sn-Doped YMnO<sub>3</sub> Perovskites for Sustainable Removal of 17 $\alpha$ -Ethinylestradiol

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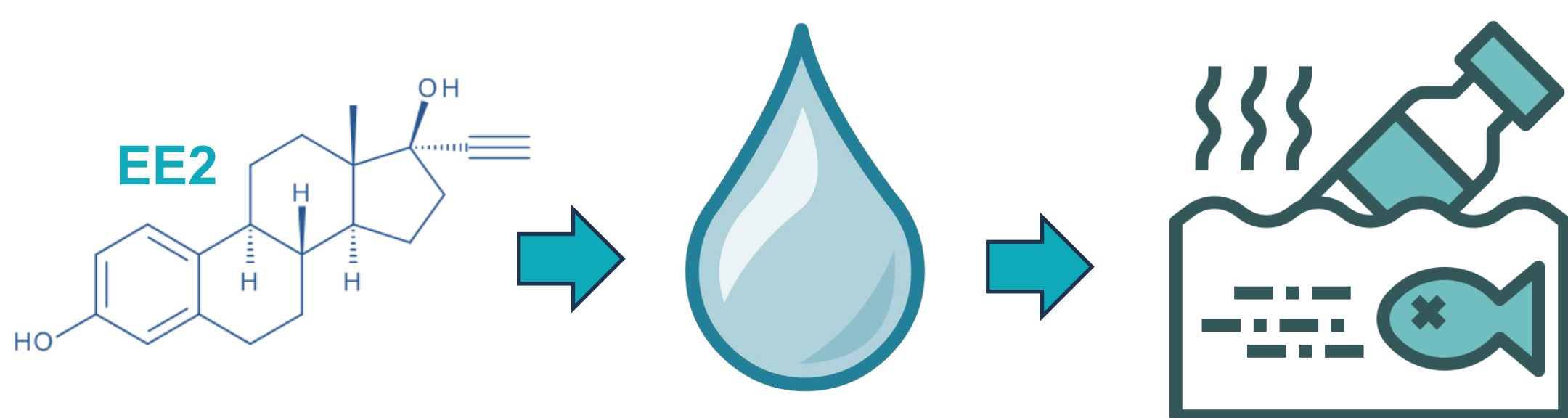
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### INTRODUCTION & AIM

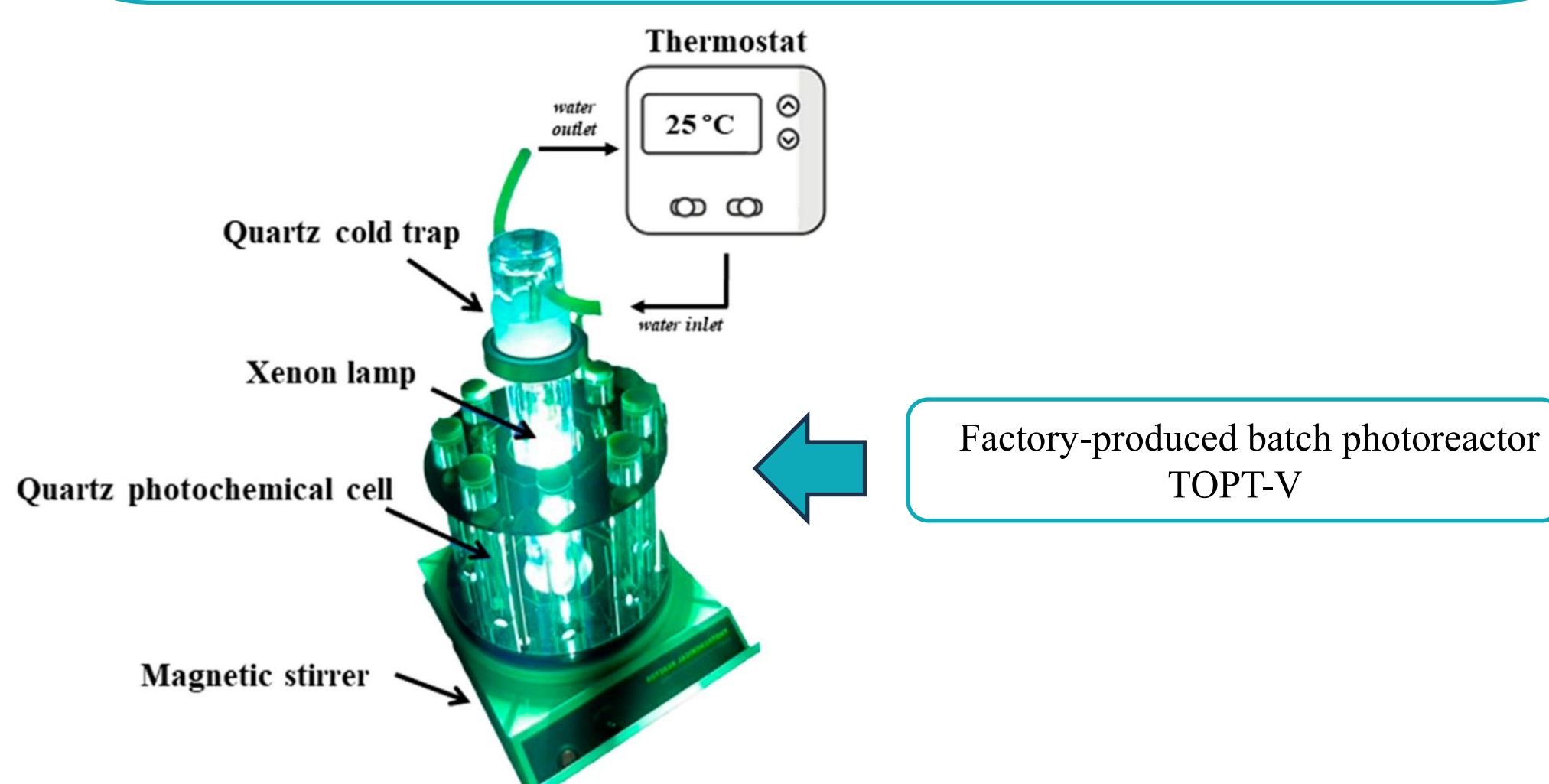
The widespread occurrence of organic pollutants in water has prompted research into advanced purification strategies. 17 $\alpha$ -ethinylestradiol (EE2), a synthetic estrogen widely used in contraceptives and hormone therapies, poses serious health risks, including prostate cancer and reduced sperm production. Heterogeneous photocatalysis, an advanced oxidation process, offers an efficient and sustainable solution for removing such contaminants.

The aim of this study was to investigate new (un)doped perovskite materials (YMnO<sub>3</sub>, Sn-doped YMnO<sub>3</sub>, and Co-doped YMnO<sub>3</sub>) in the photocatalytic degradation of EE2, under different experimental conditions (catalyst type, initial pH) using simulated solar irradiation (SSI), as well as reusability test.



### METHOD

The photocatalytic experiments were conducted in eight photochemical quartz glass cells (total volume of about 100 cm<sup>3</sup>) placed in a factory-produced batch photoreactor (Topiton-V, Topiton, Xi'an, China). A Xe lamp was employed as a source of SSI. Prior to the photocatalytic experiments, all samples were stirred for 30 min in the dark to achieve uniform distribution of the photocatalyst particles and reach the adsorption–desorption equilibrium. The reutilization study of YMO-Co in the photocatalytic removal of EE2 from ultrapure water (pH = 9) under SSI consisted of three consecutive runs, each lasting 120 min. After each run, the suspension was kept overnight in the dark to ensure YMO-Co precipitation. After supernatant removal, the photocatalyst was oven-dried for 2 h at 60 °C. To follow the degradation efficiency of EE2 under different experimental conditions, a high-pressure liquid chromatograph with a fluorescence detector (UFLC-RF, Shimadzu Nexera, Tokyo, Japan) and equipped with InertSustain® C18 column (150 mm × 4.6 mm, i.d., particle size 5  $\mu$ m) was used. The mobile phase was a mixture of acetonitrile and water (acidified with phosphoric acid).

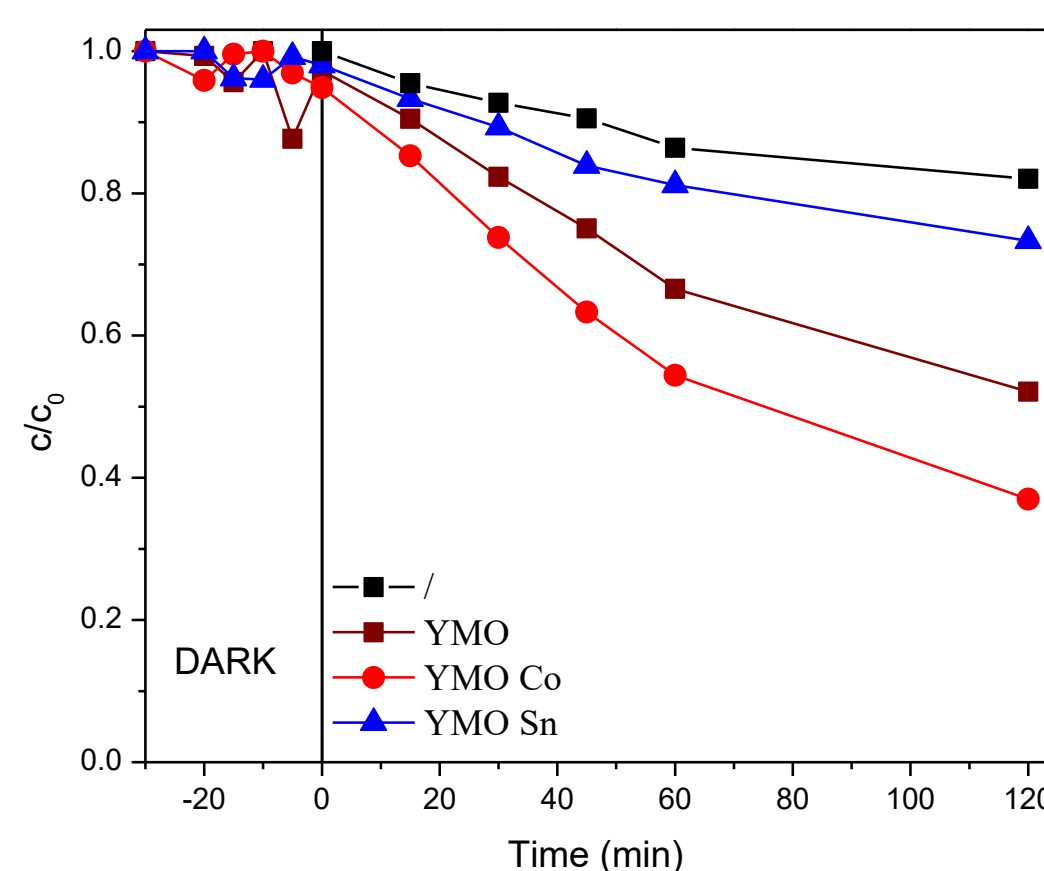


### ACKNOWLEDGEMENT

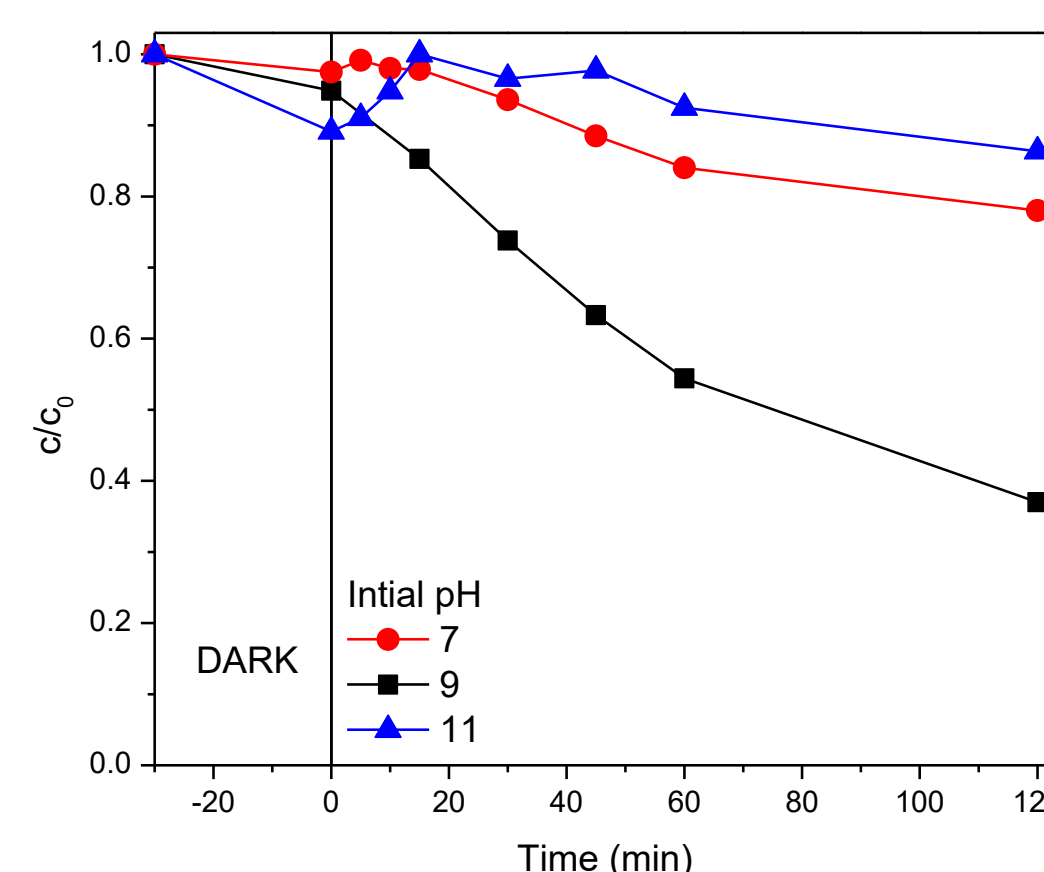
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### RESULTS & DISCUSSION

The obtained results showed that the highest photocatalytic efficiency was achieved in the presence of the Co-doped YMnO<sub>3</sub>, where 70% of EE2 was successfully removed after 120 min of SSI. The higher activity of the doped material compared to the pristine YMnO<sub>3</sub> can be explained by the sponge-like morphology and the higher surface area. Since the highest removal efficiency has been recognized in the case of Co-doped YMnO<sub>3</sub>, the experiments regarding the influence of initial pH on the photocatalytic activity were carried out in the presence of this newly prepared material. The obtained findings demonstrate that the highest removal efficiency was achieved without modifying the initial pH, i.e. at value of 9. This behavior can be explained by the favorable electrostatic interactions between YMO-Co and EE2. Moreover, photocatalyst reusability was assessed over three consecutive cycles in the presence of Co-doped YMnO<sub>3</sub>, under SSI, at pH 9 in ultrapure water. Only a slight decrease in photocatalytic efficiency ( $\leq 5\%$ ) was observed, indicating that the catalyst retained high activity even after three successive runs.



Photocatalytic removal of EE2 (0.05 mmol/dm<sup>3</sup>) in the absence/presence of various YMO-based materials ( $\gamma = 0.5$  mg/cm<sup>3</sup>) under SSI



Influence of the initial pH on the photocatalytic removal efficiency of EE2 (0.05 mmol/dm<sup>3</sup>) in the presence of YMO-Co ( $\gamma = 0.5$  mg/cm<sup>3</sup>) under SSI

### CONCLUSION

Co-doped YMnO<sub>3</sub> showed the highest photocatalytic activity toward EE2, achieving 70% removal after 120 min of SSI. The highest performance occurred at unchanged initial pH (pH = 9), likely because of beneficial electrostatic interactions. Reusability tests revealed only a slight efficiency loss ( $\leq 5\%$ ) over three cycles, confirming that Co-doped YMnO<sub>3</sub> is a stable and effective photocatalyst for EE2 degradation under SSI.

### FUTURE WORK

Future studies will include identifying degradation intermediates and assessing their potential toxicity. Moreover, additional research will also explore performance in real water samples and optimize catalyst design for even more enhanced efficiency.