

MS14-1-5 Realising the relevance of pH on photocatalytic bismuth oxyhalides
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Abstract

Photocatalytic bismuth oxyhalides is a promising family of materials for high efficiency catalytic materials. Where these have traditionally been synthesised via hydrothermal methods^{1,2}, recent developments in synthesising the material via microwave assisted synthesis has gained significant attention due to their high photocatalytic efficiencies³⁻⁵. Bi₂₄O₃₁Br₁₀, synthesised via the latter method, proved highly efficient in alcohol oxidation reactions with quantum yields of 71 % at 410 nm³ driven by a hydrogen transfer step and enhanced due to the presence of surface hydroxyls from the synthesis procedure at high pH⁴.

Our work continued the investigation of the materials obtained via microwave assisted synthesis and post synthesis modifications and how this influences the material structure and morphology. This information is linked to the photocatalytic efficiencies investigated via benzylamine oxidation reactions under UV light. The bismuth oxyhalides were synthesised at 6 different pH - ranging from low to high, yielding in BiOX (X=Br, Cl) or Bi₂₄O₃₁X₁₀, respectively. Together with the phase change upon increased synthesis pH, particle sizes decreased and photocatalytic efficiency increased. Overall, BiOBr/Bi₂₄O₃₁Br₁₀ proved a higher activity than BiOCl/Bi₂₄O₃₁Cl₁₀, which matches our observations through inelastic neutron scattering. These spectra suggest a higher degree of hydrogen saturation on Bi₂₄O₃₁Br₁₀ compared to Bi₂₄O₃₁Cl₁₀, which as previously mentioned⁴ are expected to be the driving force of the reaction. Finally, a phase transformation to BiOBr or BiOCl was observed by suspending Bi₂₄O₃₁Br₁₀ and Bi₂₄O₃₁Cl₁₀ in HBr or HCl. Despite final phases being structurally similar, a higher photocatalytic efficiency was observed in materials transformed from Bi₂₄O₃₁Br₁₀ compared to Bi₂₄O₃₁Cl₁₀.

References

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