MS14 Materials for energy storage and Conversion

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 methods1,2, 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