Mechanochemical synthesis of halide perovskite composites for solar fuels

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Halide perovskites have recently gained wide interest for their application in solar cells, optoelectronics, and artificial photosynthesis, but further progress is needed to develop greener and more scalable synthesis procedures. Herein, we report fast and convenient mechanochemical syntheses of halide perovskite nanocrystals of $CsPbBr_3$ and $Cs_2AgBiBr_6$. These perovskite nanocrystals show excellent crystallinity and tunable morphologies, from nanorods to nanospheres and nanosheets, by changing the mechanochemical reaction conditions such as ball milling time, ball size, and Cs precursor. Furthermore, we explore the mechanochemical formation of perovskite composites with copper-loaded reduced graphene oxide. All the perovskites and their composites show photocatalytic carbon dioxide conversion together with water vapours. The composites show the best performance and stability, for example 12.7 (±0.95) μmol CH_4 g^{-1} h^{-1}, 0.46 (±0.11) μmol CO g^{-1} h^{-1}, 0.27 (±0.02) μmol H_2 g^{-1} h^{-1}, and retention of 90% of this activity over three consecutive cycles for Cu-RGO-$CsPbBr_3$. This enhanced activity, selectivity, and stability are assigned to the better charge separation, visible-light absorption, CO_2 adsorption and activation, and hydrophobic character of the obtained composites. These results will contribute to the rational design and application of halide perovskites for CO_2 photocatalytic reduction

Kumar, S.; Hassan, I.; Regue, M.; Gonzalez-Carrero, S.; Rattner, E.; Isaacs, M.A.; Eslava, S. Mechanochemically synthesized Pb-free halide perovskite-based $Cs_2AgBiBr_6$–Cu–RGO nanocomposite for photocatalytic CO_2 reduction
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Biography

Dr Salvador Eslava is a Senior Lecturer (Assoc. Prof.) and EPSRC Fellow in the Department of Chemical Engineering at Imperial College London. He was recently awarded the Warner prize by the Institution of Chemical Engineers (IChemE). Before Imperial, he was a Lecturer at University of Bath (2014-2019) and a research associate in the Materials Department at Imperial College London (2011-2014) and in the Chemistry Department at The University of Cambridge (2009-2011). He defended his PhD degree in 2009 conducted in the Centre for Surface Chemistry and Catalysis (COK) at Katholieke Universiteit Leuven and IMEC, Belgium. He holds a Taught Master in Materials Science from Universitá degli Studi di Pavia, Italy, and an MEng in Chemical Engineering from Autonomous University of Barcelona, Spain. He has published more than 60 articles and received funding from different sources such as EPSRC and The Royal Society.