0D quantum dots @ 2D materials multi-structure tin monosulfide for high-performance visible light photocatalyst

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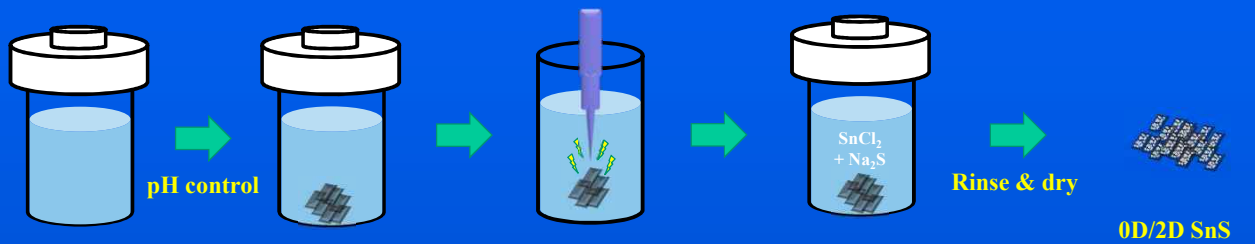
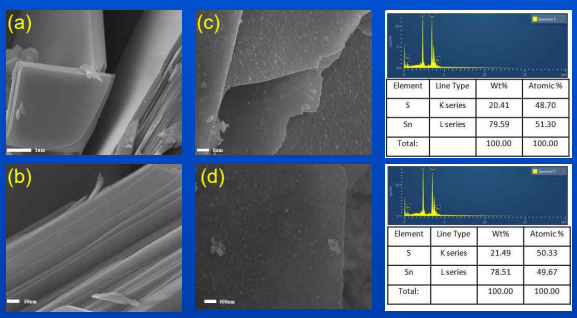
Introduction

2D materials, black phosphorus, a representative next-generation star, has very attractive characteristics, but there is a stability issue that it is weak to water and air exposure. To overcome this, a black phosphorus analogue material that has similar advantages to black phosphorus and has secured stability can be substituted. A 0D/2D composite tin monosulfide (SnS) photocatalyst was designed and synthesized by controlling the shape of this material whose band gap is controlled according to its thickness

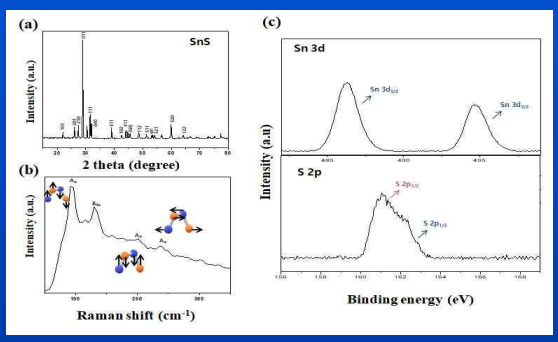
Experimental



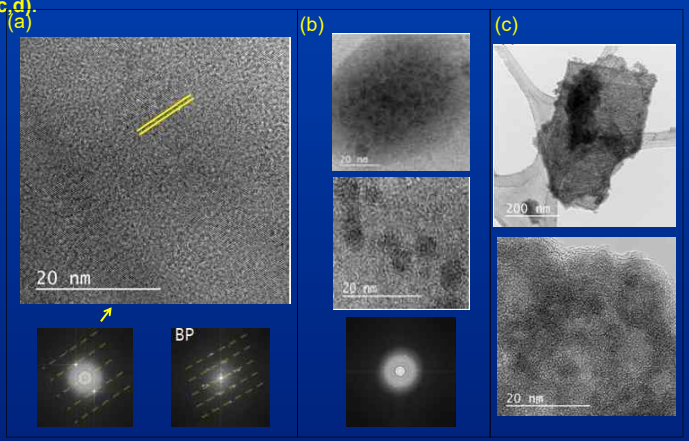
Results & Discussion



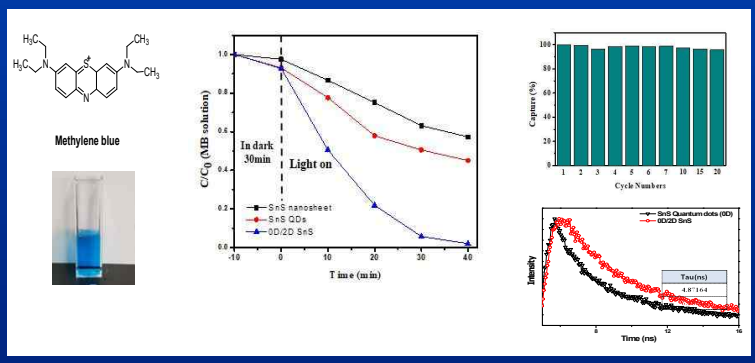
SEM images and EDS of synthesized SnS nanosheets (a,b) and 2D/0D SnS (c,d).



XRD , Raman spectra and XPS data of synthesized 0D/2D Tin monosufide nanostructure



TEM image and SAED pattern of SnS in the form of synthesized nanosheets (a), Quantum dots (b), 0D/2D SnS (c).



UV-Vis spectra of the Methylene Blue solution (20mgL-1) after put in powder until decolorization SnS and photocatalytic reaction cycles

Conclusions

In summary, in this study, using the hydrothermal method, a SnS material with a 2D nanosheet structure and a 0D quantum dots complex structure was successfully synthesized. It was possible to control the growth of SnS by adjusting the pH during the synthesis process, which was confirmed as a normal tin monosulfide orthorhombic crystal structure by measurements such as TEM, EDS, XRD, and Raman. This has been successfully proposed as a way to solve the problem of oxidation stability after exfoliation, which is the main issue of BP materials with high crystallinity and material stability. In addition, the bandgap that changes according to the thickness and dimension is designed according to the photocatalytic reaction with shape control technology. By arranging two shapes with different band gaps, the photocatalytic efficiency was increased by preventing recombination after charge separation. Additionally, we have high hopes as it has been confirmed that this material is also a promising material for water splitting hydrogen generation photocatalysts.