Improved photocatalytic & disinfection efficiency of 2D BiOCl modified by Ag nanoparticles

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2016.09.15
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Research background

◆ Energy Shortage
◆ Solar Energy
◆ Organic pollutants-AOPs
◆ Antibiotics- potential threats
◆ Semiconductors-BiOCl

BiOCl

✓ p-type semiconductors
✓ Band gap: ~3.4 eV
✓ Promising photocatalyst candidate
Experiments & characterization

- Synthesis process
- XRD, SEM, TEM characterization
- XPS, EDX, Raman Spectra
- Optical absorption property
Synthesis process

Synthesis of BiOCl

Synthesis of BiOCl-Ag
XRD of BiOCl & BiOCl-Ag

- Ag NPs
  JCPDS No. 04-0783

- BiOCl
  JCPDS Card No. 06-0249
SEM, TEM: BiOCl

Nanodiscs

Size: ~200 nm
SEM, TEM: BiOCl-Ag

- Ag NPs: 10-20 nm
- No change of morphology
XPS characterization

- High purity
- Appearance of Ag peaks
- Ag content 1.862%
EDX, Raman Spectra

- Appearance of Ag peaks
- Enhanced peak intensities
- SERS effect
- SPR effect of Ag NPs
Optical absorption property

- Enhanced absorption in the visible light range
- SPR effect of Ag NPs
- Narrowed Band gap: 3.53 vs 3.40

- Quenched peak intensity
- Lower recombination of electron-hole pairs
Result & discussion

Photodegradation of SAM

Antibacterial performance
Photodegradation of SAM

- SAM: sulfanilamide

- Increased degradation efficiency
- Lower pH led to higher efficiency
- Good stability and reusability
Antibacterial effect

- Higher efficiency under light irradiation
- Ag NPs can enhance the antibacterial efficiency
Possible mechanisms

- Absorption of visible light of Ag due to SPR effect
- Improved photo-excited electron-hole pairs separation efficiency
- Generation of various active species
- Degradation of SAM due to active species
- Antibacterial effect due to active species and Ag
Photostability of BiOCl-Ag

- No clear change of morphology
- No clear change of crystallinity
- Good photostability!
Conclusions

- Introduction of Ag NPs affected the properties of BiOCl
- BiOCl-Ag composites presented significant improved photocatalytic properties
- SPR effect of Ag NPs plays an important role
- BiOCl-Ag composites are promising candidate as photocatalysts
Thank you