Infrared Energy Conversion in Plasmonic Fields at Two-Dimensional Semiconductors

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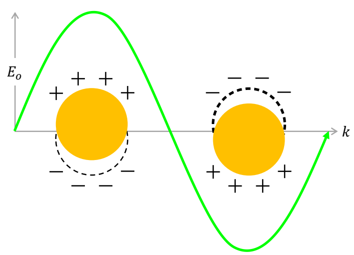
Background

- plasmons localize resonant energy below the diffraction limit



resonant enhancement could permit passive conversion of infrared energy to visible energy

$$\vec{P} \propto \chi^{(1)}\vec{E} + \chi^{(2)}\vec{E}^2 + \chi^{(3)}\vec{E}^3$$

linear nonlinear

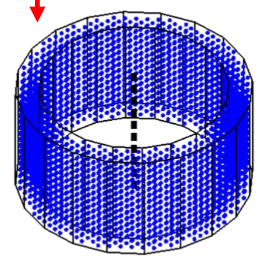
Innovation

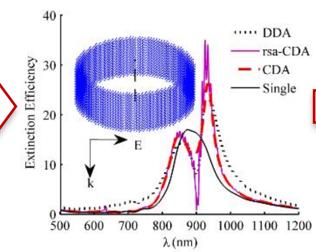
- alternative nanoantenna geometries
- models which bridge near-field physics with far-field observables
- coupling nonlinear electromagnetism with solid-state materials

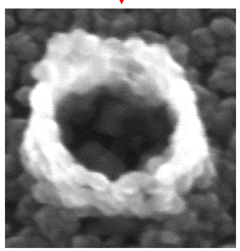
Approach

design metamaterials to enhance nonlinearities of 2D semiconductors

- discrete and coupled dipole approximations (DDA and CDA)
- nano-imprint, electron-beam, & soft lithography
- SEM, TEM, & STEM electron microscopy
- multi-photon confocal microscopy

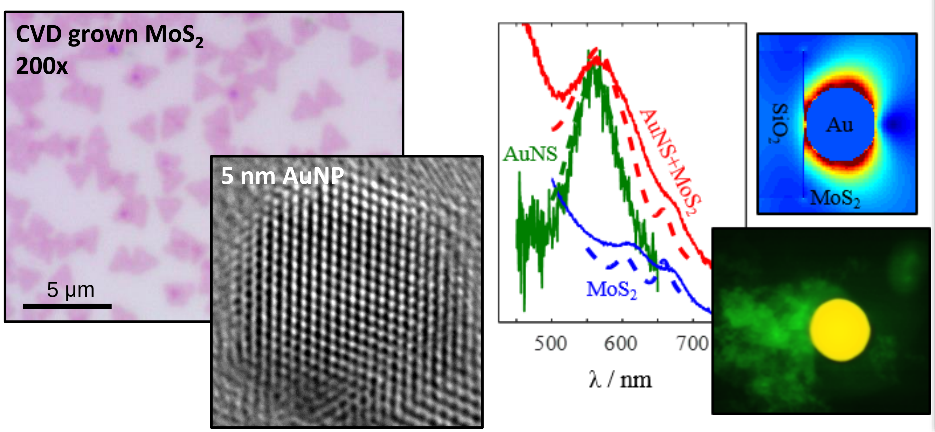






Key Results

- demonstrated plasmon-enhanced second harmonic generation (SHG)
- measured plasmonic energy transfer into MoS_2/WS_2 with STEM-EELS



Conclusions

- plasmonic hot electron transport
- improved nonlinear frequency conversion
- first model to guide design

Potential Applications

- energy harvesting
- wearable medical devices
- photonic circuitry
- 2D electronics
- biological sensors
- portable power generation
- heat rejection

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