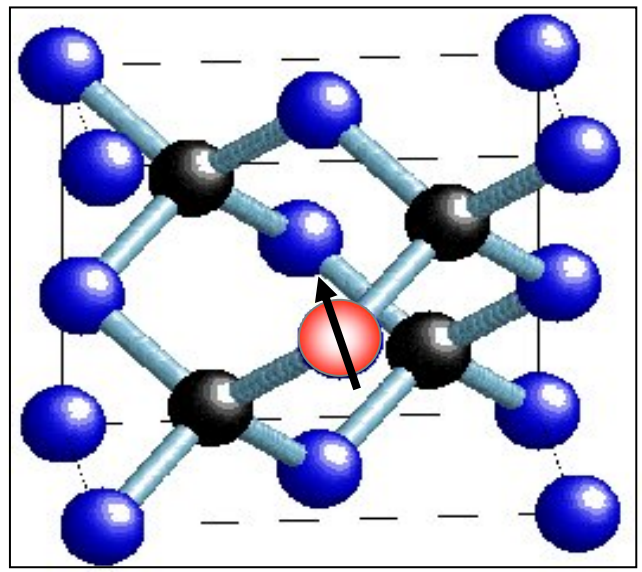
Stable Photogenerated Carriers in Magnetic Semiconductor Nanocrystals

Can we control the ferromagnetic properties of diluted magnetic semiconductor (DMS) nanocrystals by controlling the charge carrier concentration?

"If we can understand and control the spin degree of freedom in semiconductors, the potential for high-performance spin-based electronics will be excellent"

-Wolf et. al. Science 2001, 294, 1488-1495



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March 7, 2006

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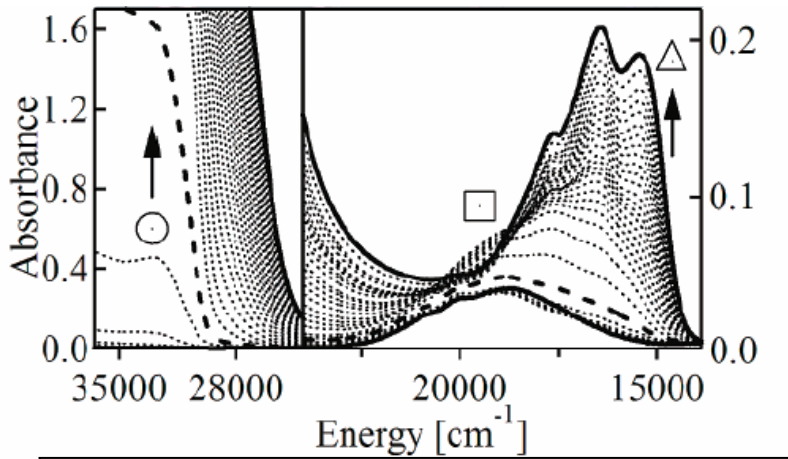
Stable Photogenerated Carriers in Magnetic Semiconductor Nanocrystals

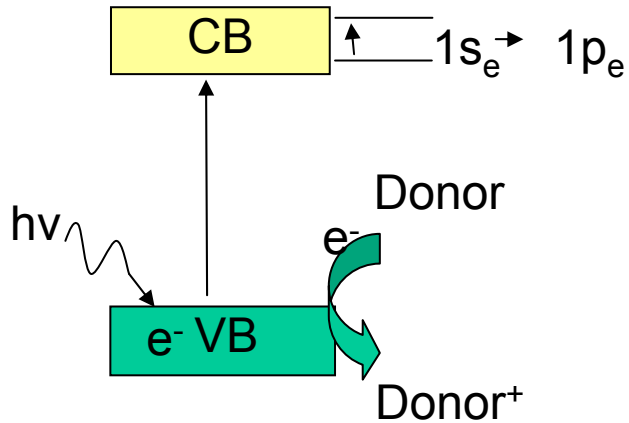
Synthesis:

$$(1-x)Zn(OAc)_2 + xCo(OAc)_2 + 2NMe_4OH \rightarrow Co^{2+} : ZnO + H_2O + 2NMe_4OAc$$



Photochemical Reduction:

Air-free colloidal suspensions in toluene/ethanol



After reduction, nanocrystals are stable indefinitely in anaerobic environment

Electronic Absorption Spectroscopy Expected Spectral Changes:

- ***Band Gap Bleaching***
- ***Strong IR Absorption***

Magnetism:

- ***Electron Paramagnetic Resonance (EPR) Spectroscopy***
- ***Superconducting Quantum Interference Device (SQUID) Magnetometry***

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Schwartz, Norberg, Nguyen, Parker, Gamelin, *JACS* **2003**, *125*, 13208

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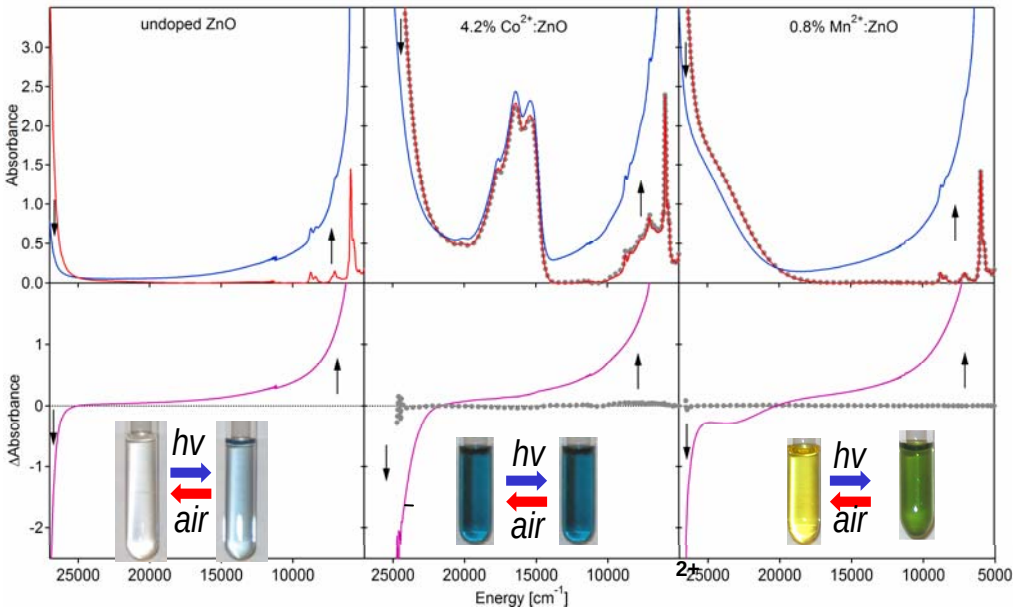

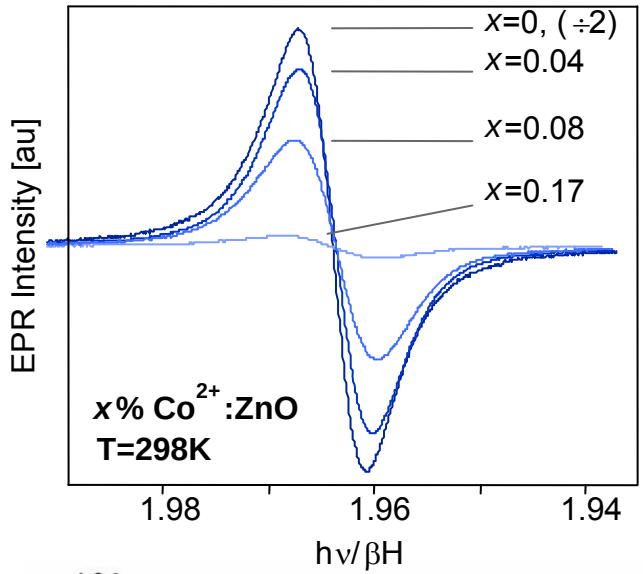

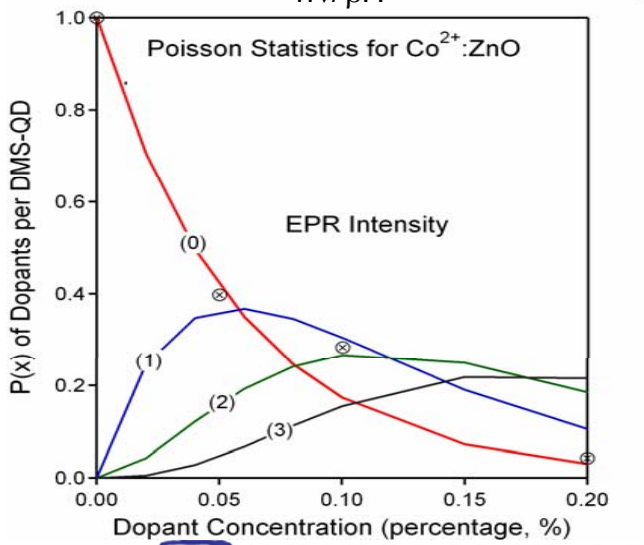

Conclusions:

TM^{2+}:ZnO can be photochemically reduced

An electron was successfully injected into the conduction band

Future Work:

SQUID magnetic susceptibility – How can we best describe the magnetic properties of this system?

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Liu, W.K.; Whitaker, K.M.; Kittilstved, K.R.; Gamelin, D.R. *JACS*, **2006** *accepted*