Department of Chemistry

Mesoporous Semiconductors

Our researches mainly focus on the synthesis and characterizations of mesoporous and semiconductor materials with unique optical, electrical, magnetic and spintronic properties. Current research covers board topics of nano-material applications, including surface-enhanced Raman scattering (SERS), CO_2 reduction reactions (CO_2RR), diluted magnetic semiconductors (DMS) in fundamental aspects.

Techniques used in study

Powder X-ray diffraction (XRD), scattering (SAXS/GISAXS), absorption (EXAFS), EPR, MCD, time-resolved fluorescence microscopy, Raman, GC, TEM/HRTEM, SEM, AFM, BET *et al.*

Yihsin Kyle Liu, Assistant Professor
Department of Chemistry
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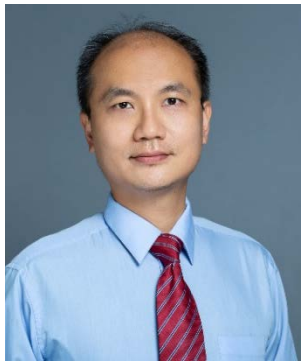


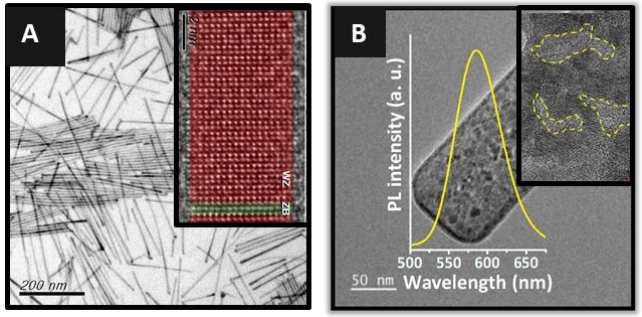
Background:

PhD in Chemistry, Washington University, St. Louis, MO, USA

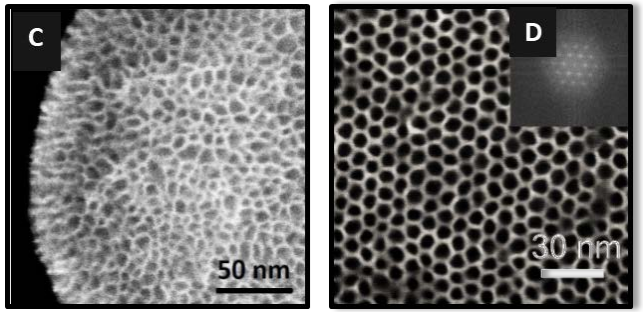
Funding:

Ministry of Science and Technology
Ministry of Education

Heterostructured 1D Nanowire and 2D Nanosheets



Mesoporous Nanoparticles and Thin-Film Materials

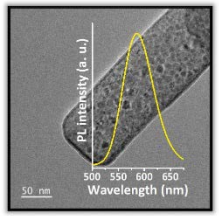


Publications

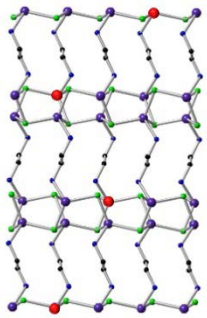
- Kao, K.-C.; Lin, C.-H.; Chen, T.-Y.; **Liu, Y.-H.**; Mou, C.-Y., A General Method for Growing Large Area Mesoporous Silica Thin Films on Flat Substrates with Perpendicular Nanochannels. *J. Am. Chem. Soc.* **2015,** *137*, 3779-3782
- Hsieh, T.-E.; Yang, T.-W.; Hsieh, C.-Y.; Huang, S.-J.; Yeh, Y.-Q.; Chen, C.-H.; Li, E. Y.; **Liu, Y.-H.**, Unraveling the Structure of Magic-Size $(CdSe)_{13}$ Cluster Pairs. *Chem. Mater.* **2018,** *30*, 5468-5477.
- Chang, H.-J.; Chen, T.-Y.; Zhao, Z.-P.; Dai, Z.-J.; Chen, Y.-L.; Mou, C.-Y.; **Liu, Y.-H.**, Ordered Mesoporous Zeolite Thin Films with Perpendicular Reticular Nanochannels of Wafer Size Area. *Chem. Mater.* **2018,** *30*, 8303-8313.

2D Spintronics

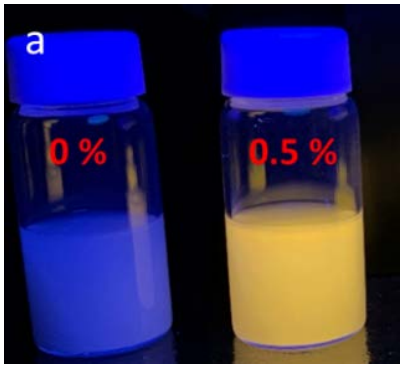
PL/HRTEM



Mn^{2+}



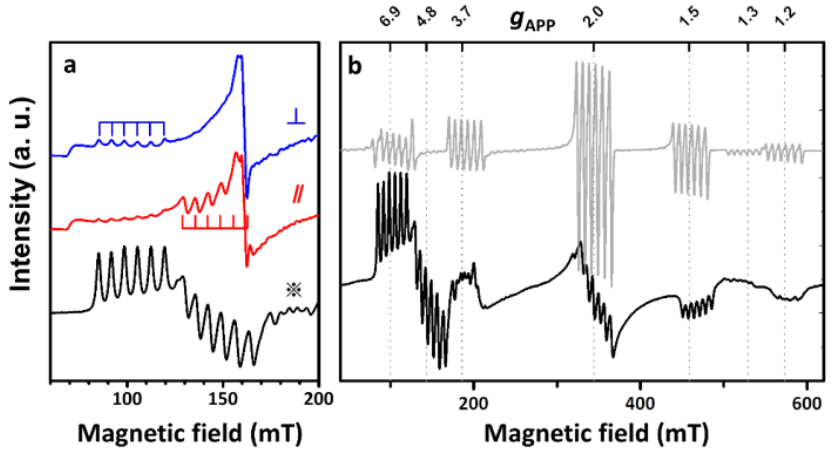
monolayer



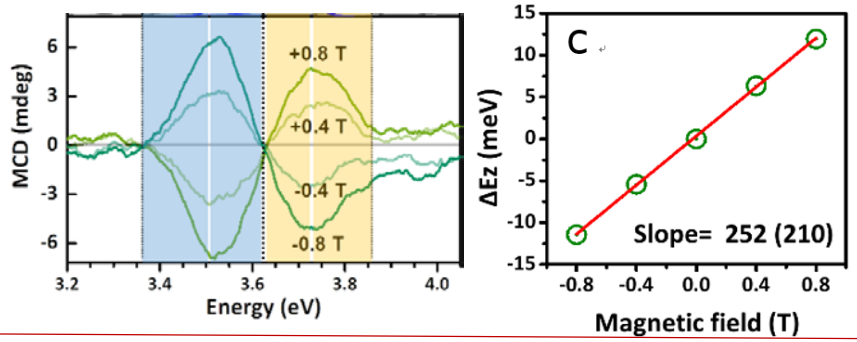
Highlights

Single-crystalline CdSe(ethylenediamine)$_{0.5}$ nanosheets with tunable Mn^{2+} (0.5-8.0%) are synthesized, showing strong phosphorescence ($^4T_1 \rightarrow {}^6A_1$) and long lifetimes (20.5, 132, 295 µs). Temperature-varied EPR spectroscopy with spectral simulation reveals anisotropic ZFS (D=3850 MHz) due to axial distortion of substituted Mn^{2+} (S=5/2). Additionally, giant Zeeman splitting with large effective g-values (up to 231±21) in magnetic circular dichroism (MCD) suggests quantum confinement, spin-orbital interaction and huge *sp-d* exchange interaction in 2D monolayer regimes.

EPR simulation for an S=5/2 spin system



Magneto-Optically Transitions in Fields



Publications

- Li, C.; Hsu, S. C.; Lin, J. X.; Chen, J. Y.; Chuang, K. C.; Chang, Y. P.; Hsu, H. S.; Chen, C. H.; Lin, T. S.; **Liu, Y.-H.**,* Giant Zeeman Splitting for Monolayer Nanosheets at Room Temperature. *J. Am. Chem. Soc.* **2020**, 142, *49*, 20616–20623.
- **Liu, Y.-H.**, Li, T.; Chitara, B.; Goldberger, J. E.,* Li Intercalation into 1D TiS_2(en) Chains . *J. Am. Chem. Soc.* **2014,** *136*, 2986-2989.
- **Liu, Y.-H.**; Porter, S.H.; Goldberger, J.E.,* Dimensional Reduction of a Layered Metal Chalcogenide into a 1D Near-IR Direct Band Gap Semiconductor. *J. Am. Chem. Soc.*, **2012,** *134*, 5044-5047.