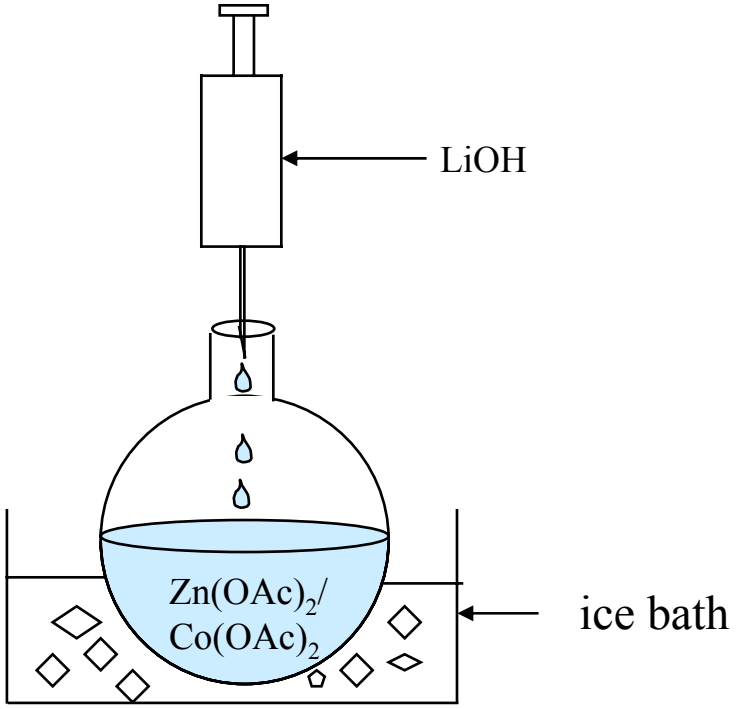
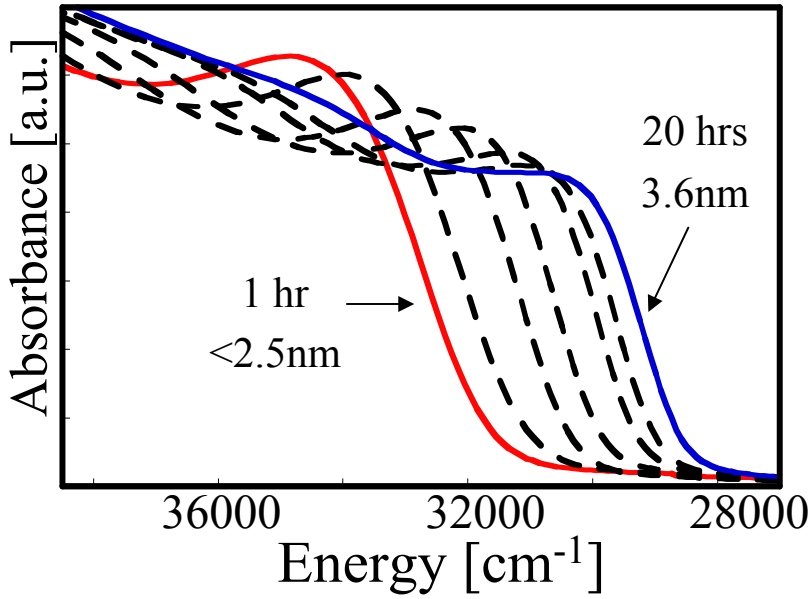
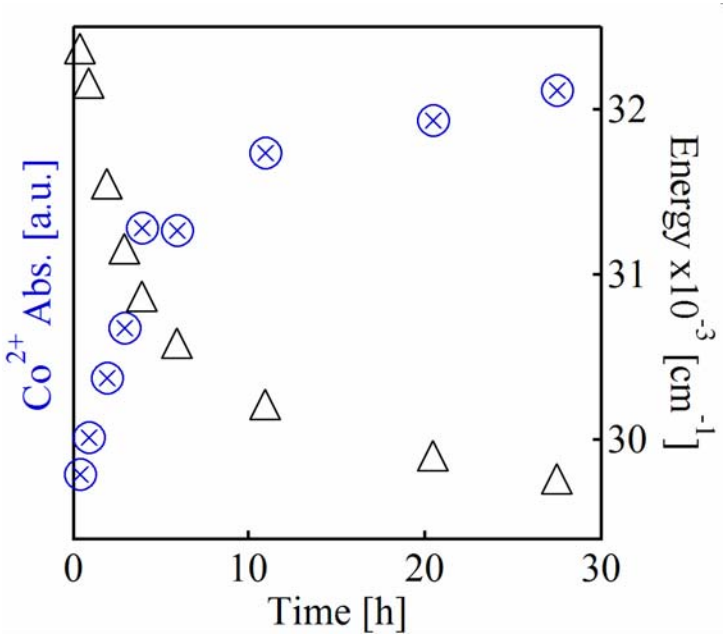
Synthesis of ZnO Quantum Dots

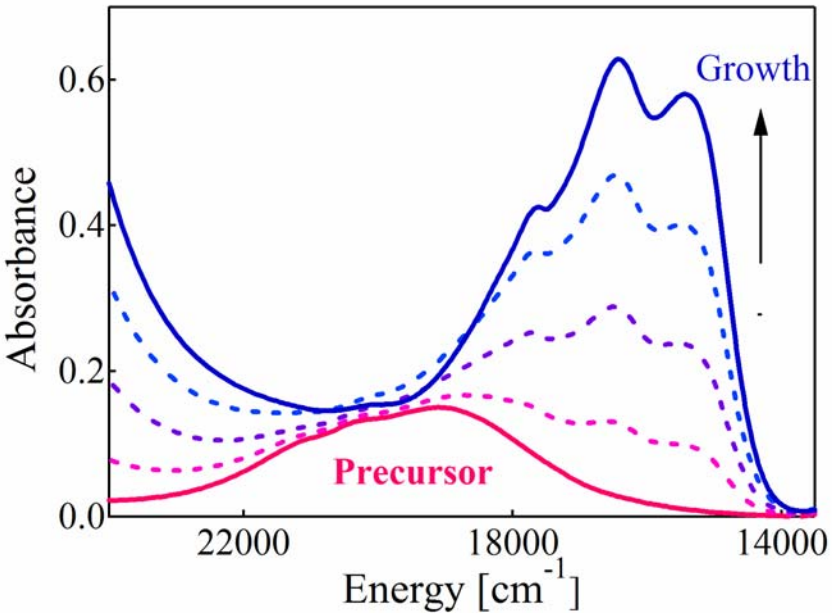




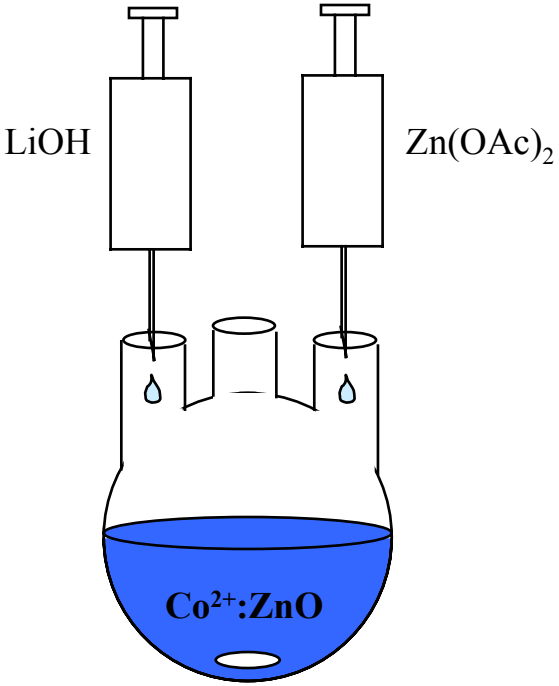
Radovanović, Norberg, McNally, Gamelin, *J. Am. Chem. Soc.*, **2002**, *124*, 15192-15193

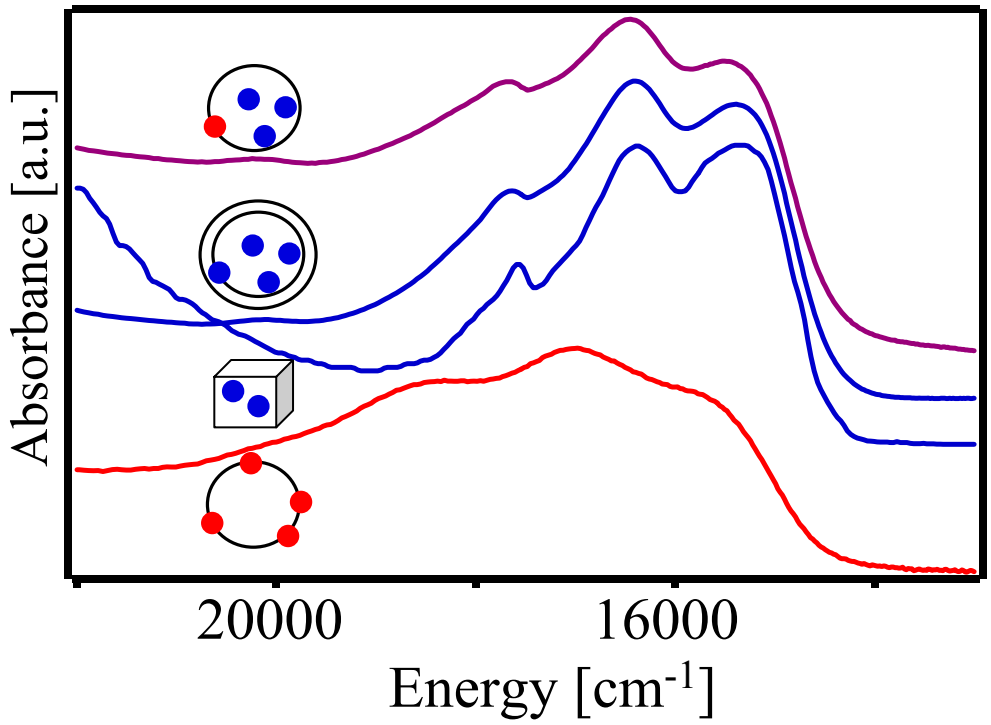
Ligand-Field Absorption Spectroscopy During Nanocrystal Growth





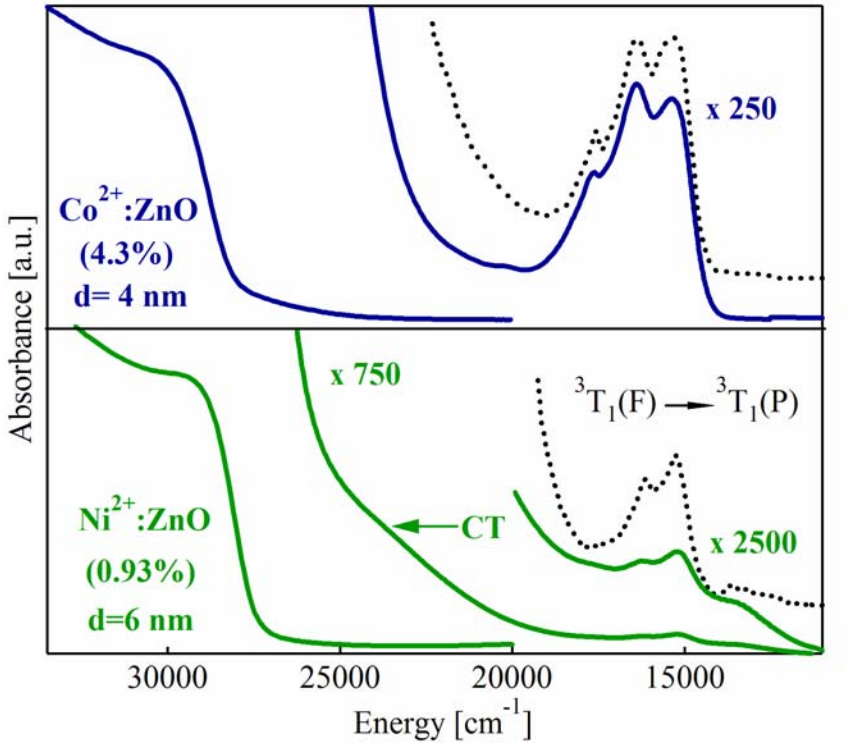
Isocrystalline Core/Shell Procedure

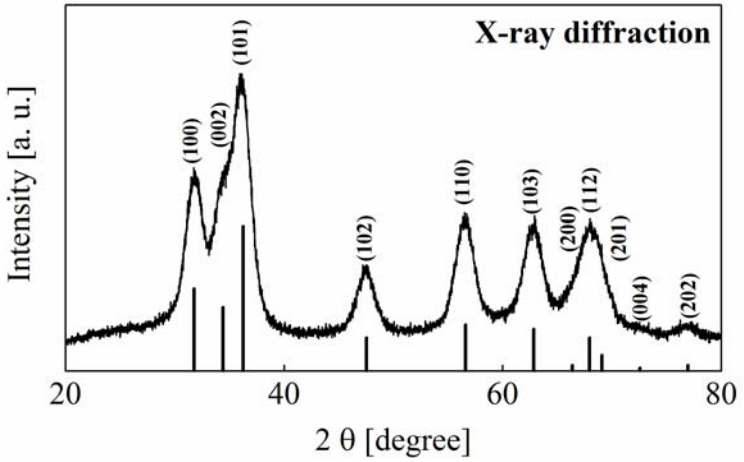


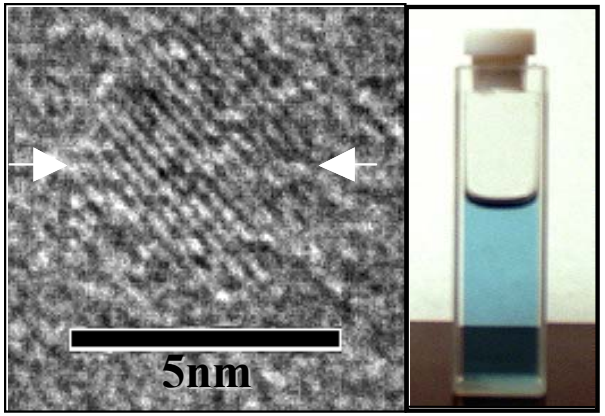


Bulk spectrum: Weakliem, *J. Chem. Phys.* **1962**, *36*, 2117

Colloidal ZnO DMS QDs







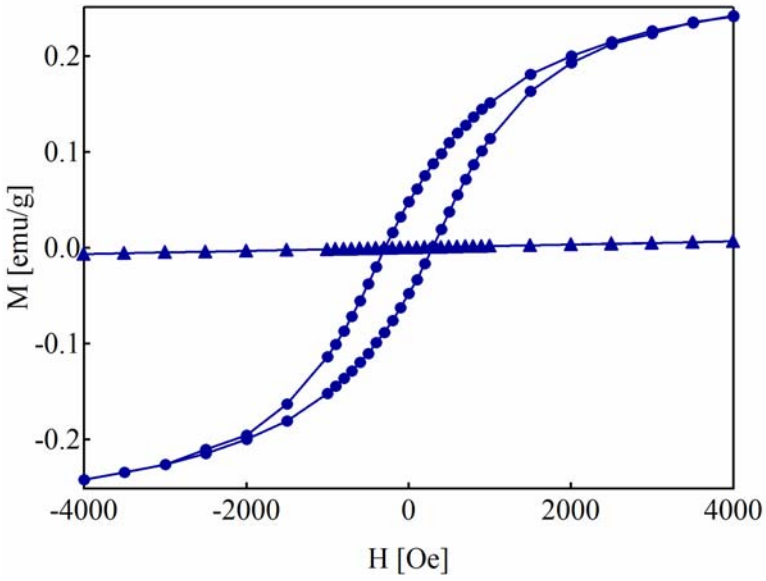
Radovanović, Norberg, McNally, Gamelin, *J. Am. Chem. Soc.* **2002**, *124*, 15192-15193

High-T_c Ferromagnetism in Co^{2+}:ZnO and Ni^{2+}:ZnO

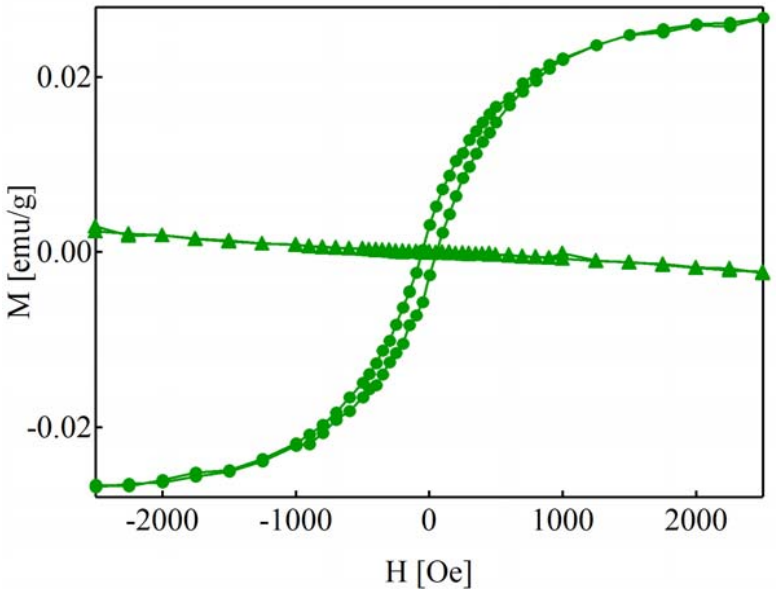
- Chemical approach to generation of high-T_c ferromagnetic semiconductors

T=350 K

Co^{2+}:ZnO aggregates

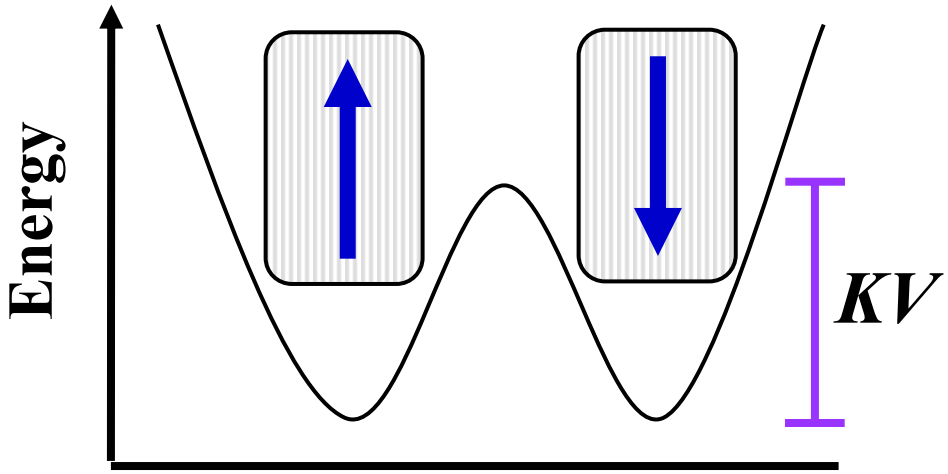


Ni^{2+}:ZnO aggregates



Radovanović P. V., Gamelin D. R., *in preparation*

Ferromagnetism in a Single Nanocrystal



K = *magnetocrystalline anisotropy factor*

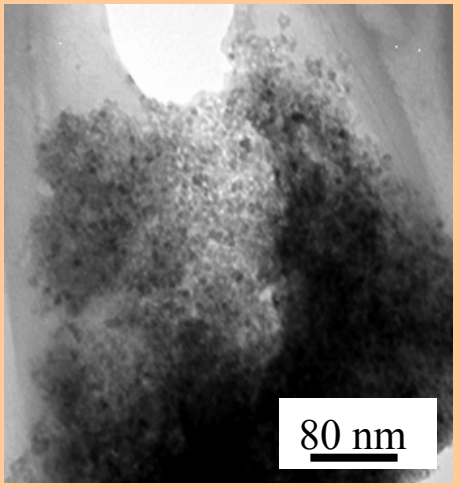
V = *crystal volume*

Magnetization Lifetime: $\tau = \tau_0 \exp[KV / kT]$

Aggregation:

Increases Domain Volumes

Introduces Defects



Reaction-Limited Aggregation of Colloidal DMS QDs

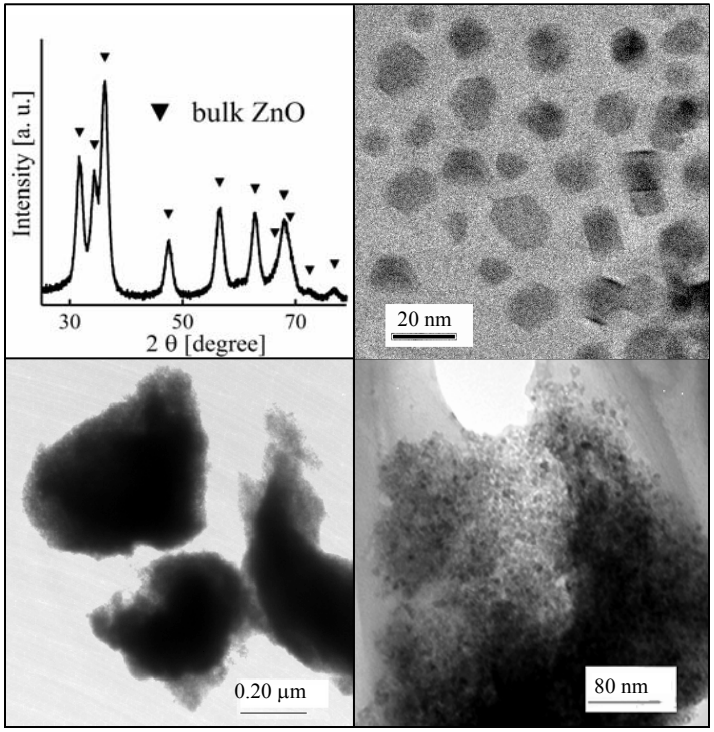
Derjaguin-Landau-Verwey-Overbeek Model

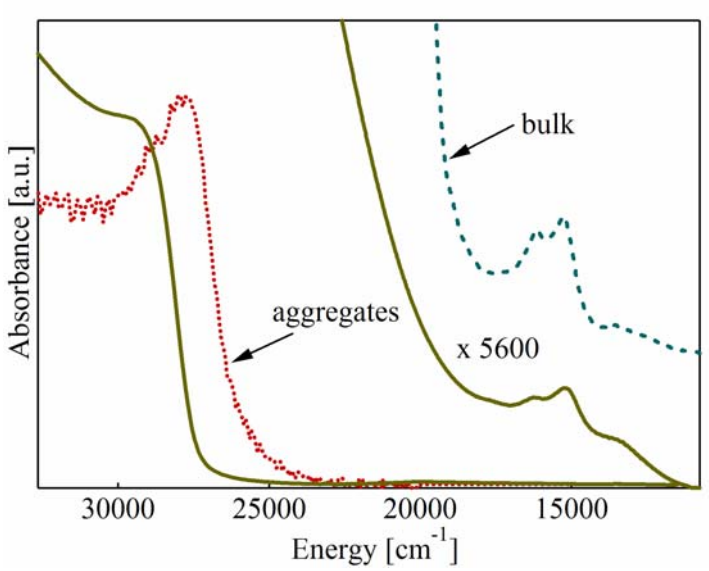
$\gamma \sim exp[-E_b/kT]$ (probability)

$E_b >> kT$ stable colloids

$E_b << kT$ diffusion-limited aggregation

$E_b > kT$ reaction-limited aggregation

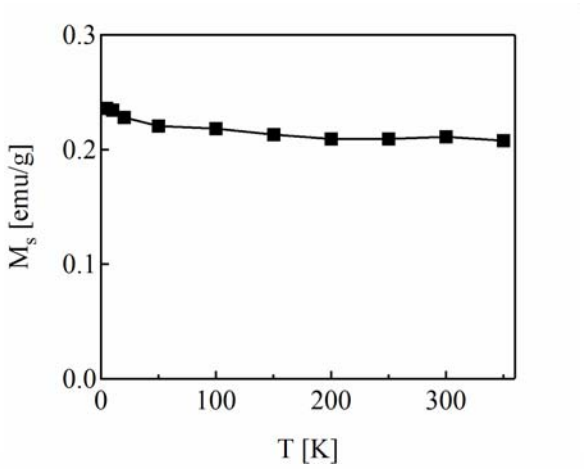


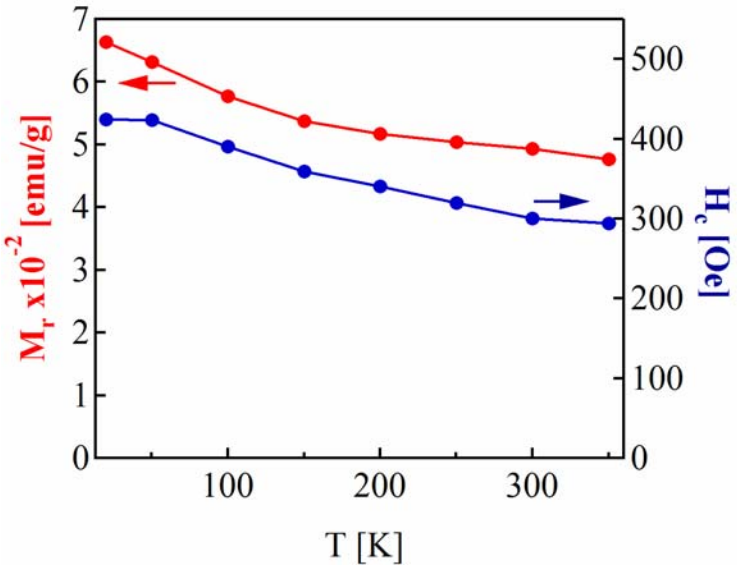


Radovanović P. V., Gamelin D. R., manuscript in preparation

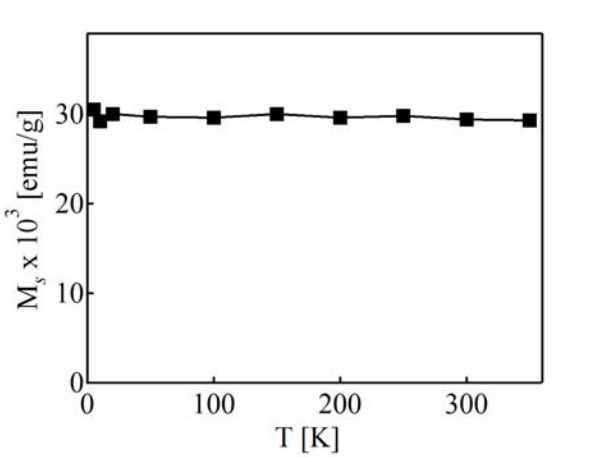
Hysteresis Properties of Nanocrystaline Aggregates

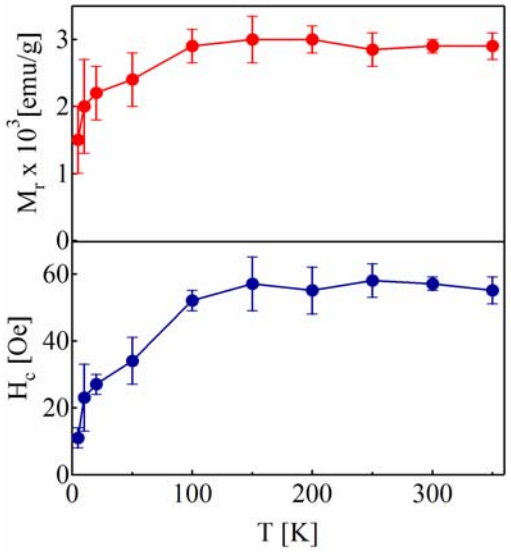
4.3 % Co^{2+}:ZnO



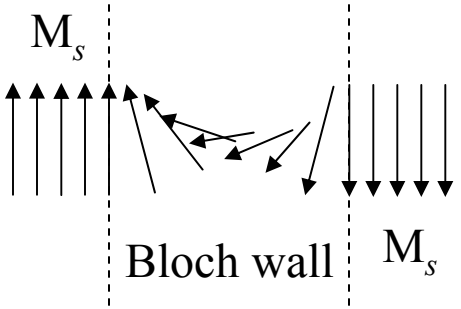


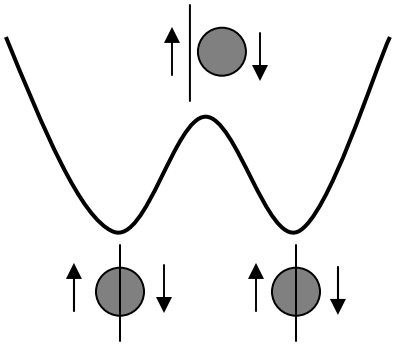
0.93 % Ni^{2+}:ZnO

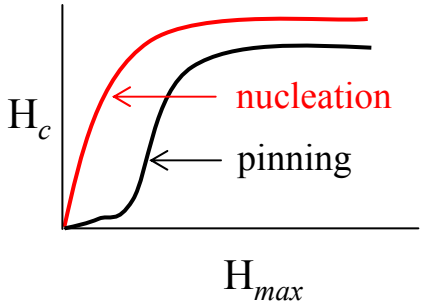




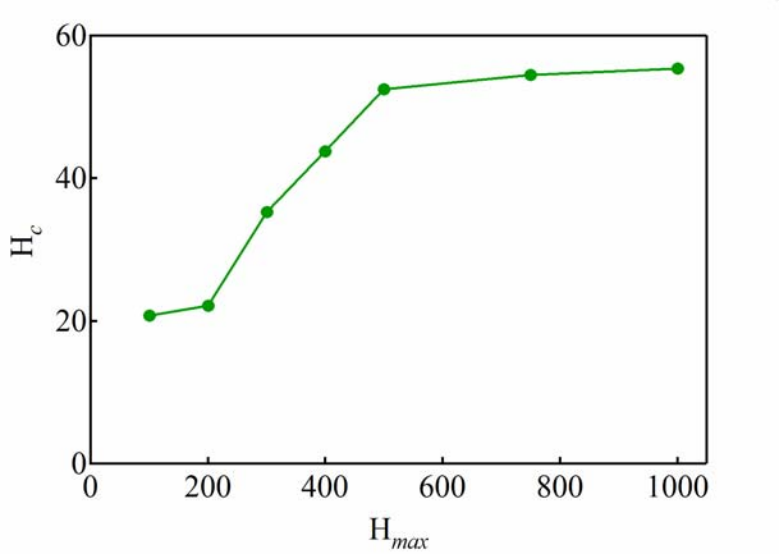
Domain Wall Movement Mechanism



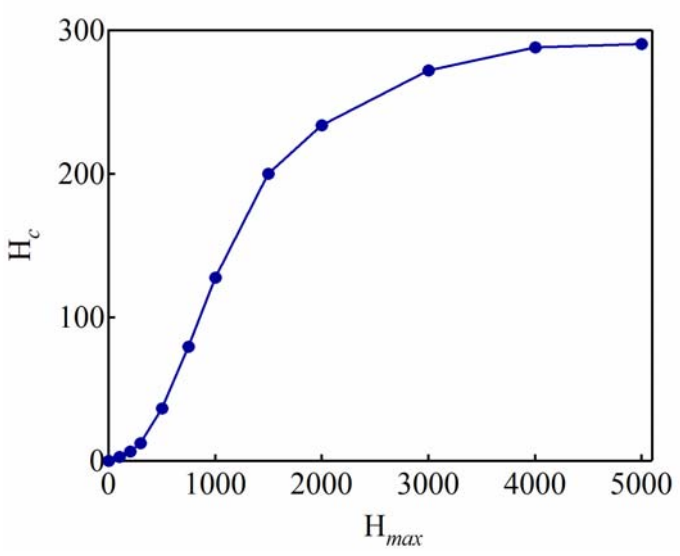




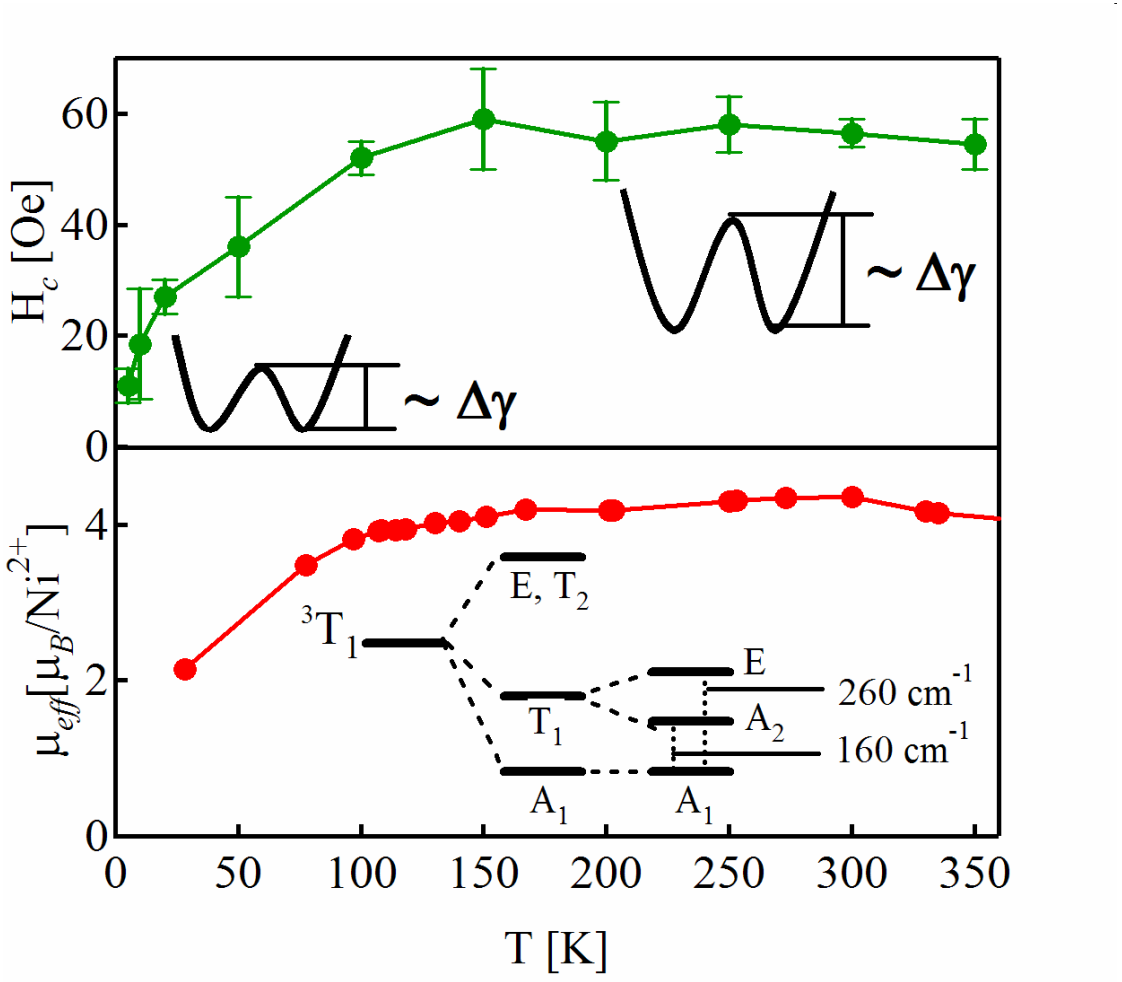
Ni^{2+}:ZnO



Co^{2+}:ZnO



Temperature Dependence of the Domain Wall Movement



Conclusions

- Isocrystalline core/shell synthetic methodology
- Electronic absorption spectroscopic techniques
- High temperature (> 350 K) ferromagnetic ordering intrinsic property of both Co^{2+}:ZnO and Ni^{2+}:ZnO
- Chemical control of magnetism through reaction-limited aggregation
- Hysteresis properties are function of the barrier to the domain wall movement
- New opportunities for study and application of DMSs at the nanometer length scale

Acknowledgements

Research:

- Daniel Gamelin
- Gamelin Research Group
- Dr. Chongmin Wang/Dr. Scott Chambers (PNNL)
- Jim Roe (Dept. of Chemistry, UW)

Funding:

- Center for Nanotechnology (UW)
- NSF-*CAREER*
- NSF-*SPIN ELECTRONICS*
- Petroleum Research Fund (administered by ACS)
- Semiconductor Research Corporation
- Research Corporation
- Royalty Research Fund (UW)
- JIN (UW/PNNL)
- University of Washington