Molecular layers and electric fields as tools for controlling magnetism in nanostructured systems

Liza Herrera Diez
Institut Néel-CNRS, Grenoble, France
Outline

Light-sensitized magnetic devices
- Diluted magnetic semiconductors-GaMnAs
- Dye-molecule functionalization
- Light-exposure effect on magneto-transport properties

Electric-field-effect magnetic devices
- FePt-Coercive field distributions
- Electric-field effect on magnetotransport properties-dielectric barriers
Light-sensitized magnetic devices

Diluted magnetic semiconductors-GaMnAs

Zinc-blende structure

- Interstitial Mn
- Substitutional Mn
- Magnetic moment
- Holes

Hole mediated ferromagnetism
Light-sensitized magnetic devices

Diluted magnetic semiconductors-GaMnAs

GaMnAs 40 nm
GaAs buffer layer
GaAs (001) substrate

magnetization in-plane

[010] [110] [100] [110]

uniaxial+biaxial anisotropy

![Kerr signal vs Magnetic Field (Oe)](image1)

![Magnetic domain images](image2)
Light-sensitized magnetic devices

Dye-molecule functionalization

50 nm

GaMnAs

GaAs

Ga 3d peak

\( \text{Ga}_2\text{O}_3 \)

GaAs valence band

Normalized intensity

Binding energy (eV)

Normalized intensity

Binding energy (eV)
Light-sensitized magnetic devices

Dye-molecule functionalization

Hole mediated ferromagnetism

\[ T_c \propto p^{1/3} \]

\( p \): charge carrier concentration
Dye-molecule functionalization

- **Fluorescein**
- **Eosin Y**
- **Phloxine B**

![Graph showing normalized resistance vs. temperature for different dye-functionalized GaMnAs.](image)
Light-sensitized magnetic devices

Light-exposure effect on magnetotransport-properties
Electric-field-effect magnetic devices

FePt-Coercive field distributions
Electric-field effect on magnetotransport properties-dielectric barriers

Electric-field-effect magnetic devices
Acknowledgements

D. Givord  
L. Ranno  
A. Bernand-Mantel

K. Kern  
J. Honolka  
M. Konuma

References:

Thank you