

1126

Motivation

Study electro-optic effect on colloidal QD and eventually build an electro-optic modulator for chip to chip communication

Advantages

- Easier to fabricate compared to top down approach
- Easy to deposit – spin coat/Langmuir Blodgett-fast/self assembly
- Can be incorporated into polymers or glass (no lattice matching requirements)

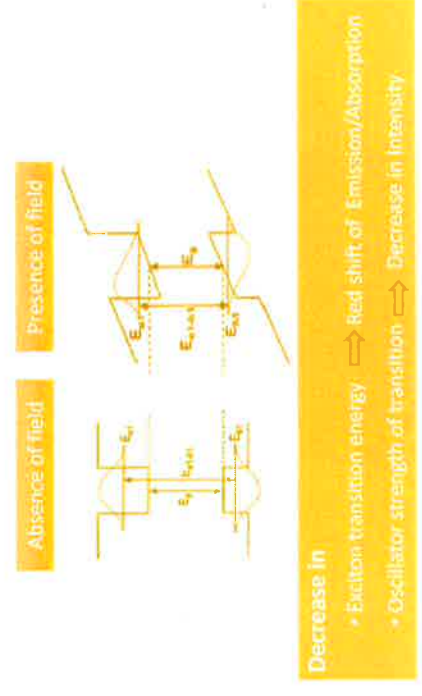
Effect of electric field on CdSe/CdS/ZnS Colloidal Quantum Dots

Sreeparvathi Warriar, Karel Lambert, Jolien Dendooven, Christophe Detavernier, Zeger Hens, Dries Van Thourhout



Quantum Confined Stark Effect

Effect of electric field on band energy of exciton



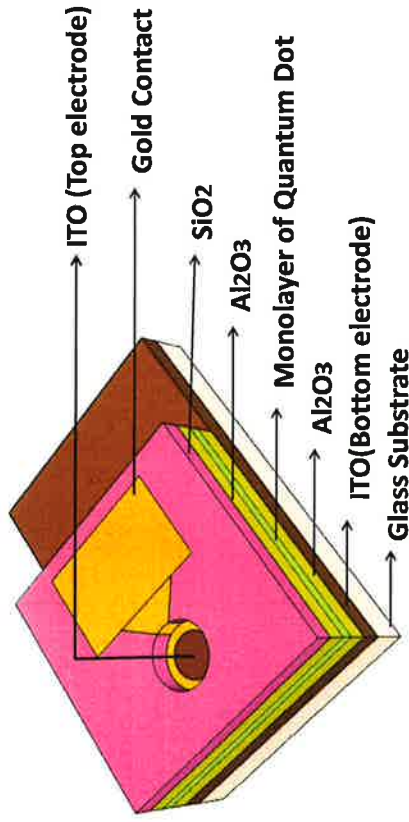
$$\text{Stark shift} \propto E^2$$

Why CdSe/CdS/ZnS ?

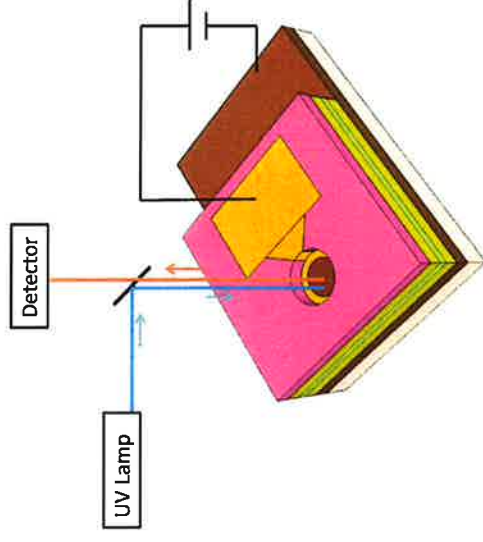


- i. Why CdSe? Stable , fluorescent
- ii. Why CdSe/CdS ?
 - i. Increased spatial separation of electron and hole, hence greater QCSE – electron delocalized over the core and shell hole localized in core
 - ii. Highly fluorescent due to greater coordination of dangling bonds
- iii. Why CdSe/CdS/ZnS? ZnS protects from deterioration during further processing

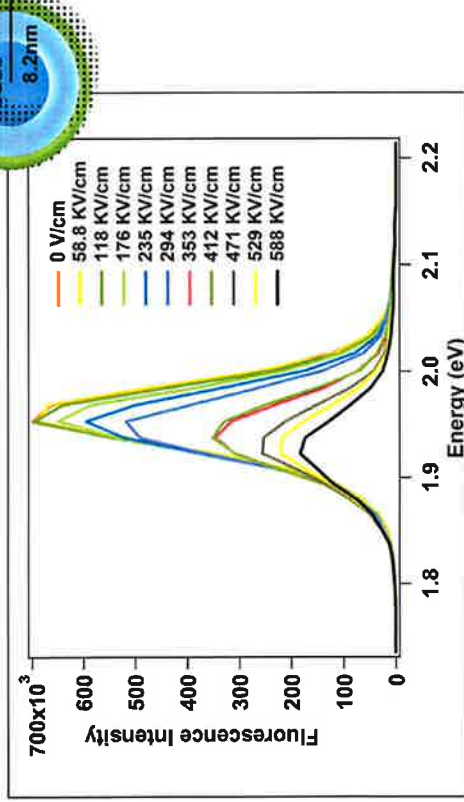
Sample



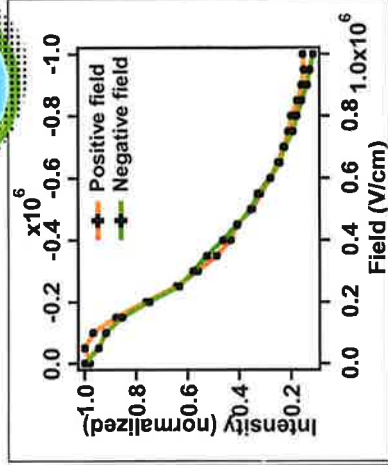
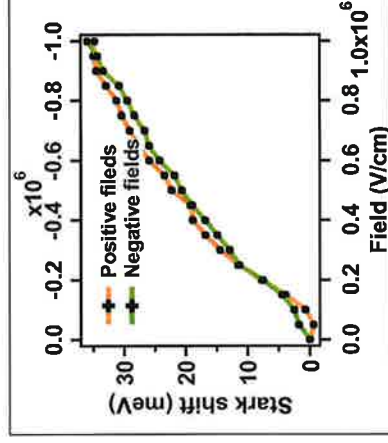
Luminescence Measurement



Luminescence under electric field

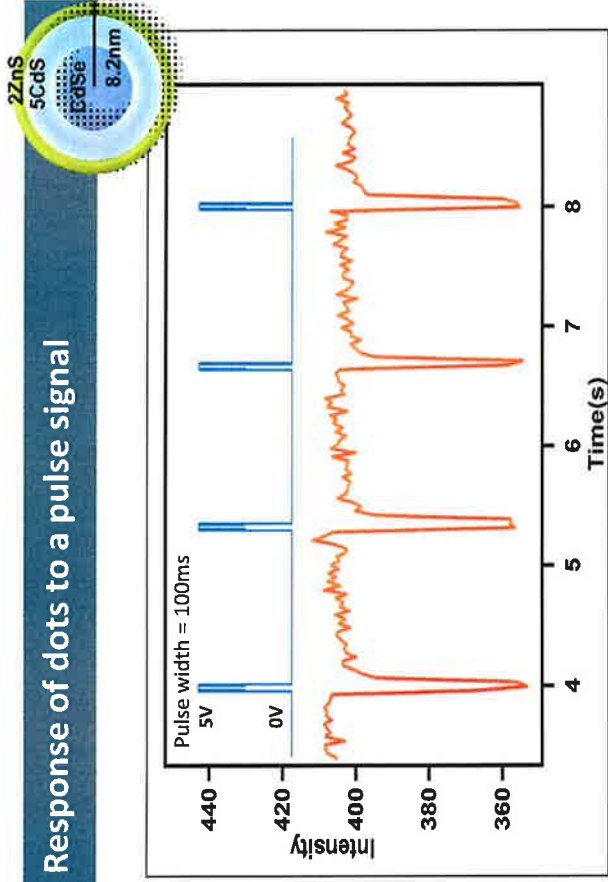


Stark shift

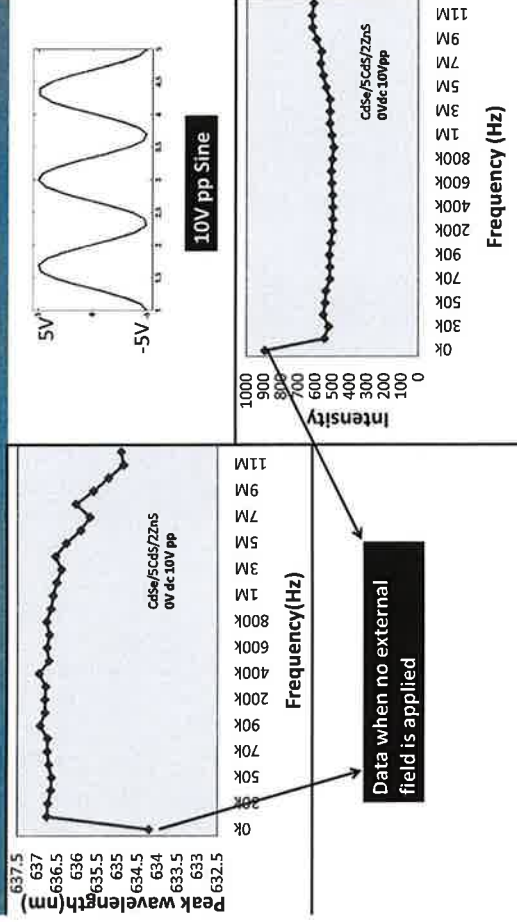


Similar shifts were obtained for different excitation powers

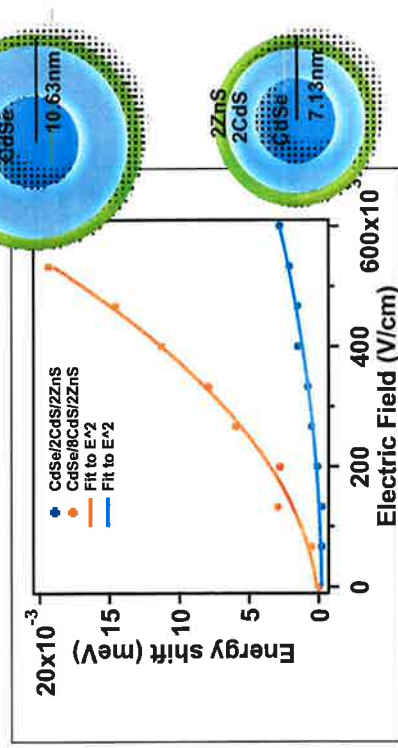
Response of dots to a pulse signal



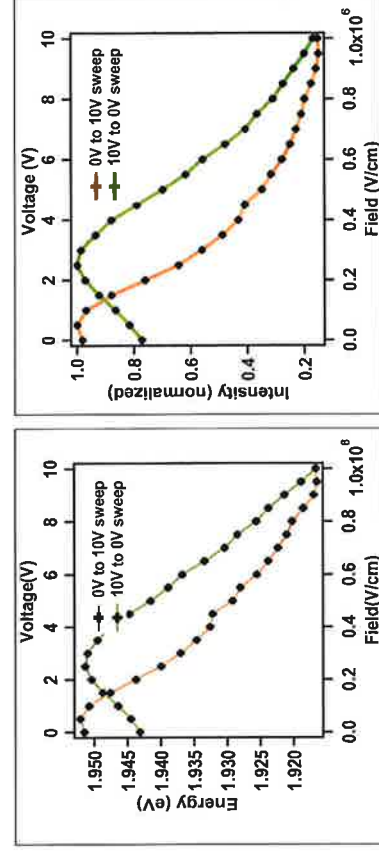
Response to sinusoidal signal



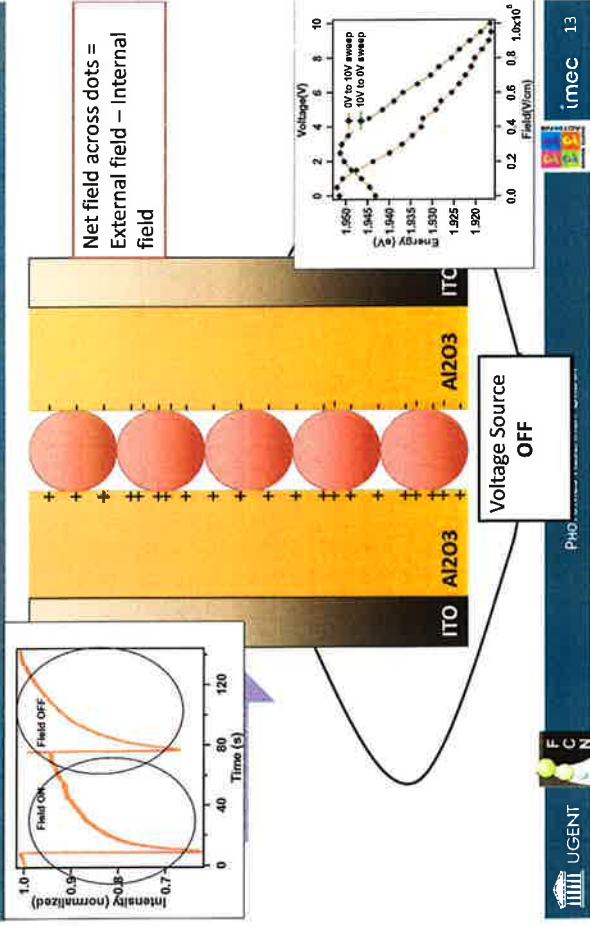
Size dependence on stark shift



Change in stark shift due to internal field



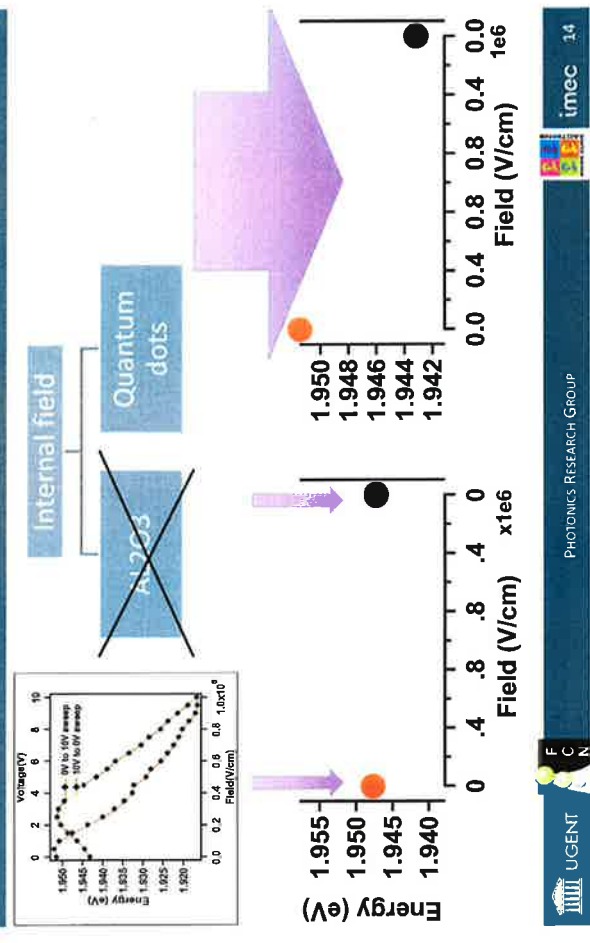
Build up of internal field



Summary

- Stark effect in luminescence from CdSe/CdS/ZnS colloidal quantum dots had been studied
- Stark shift proportional to size of quantum dot
- Possibility to tune the luminescence intensity and band gap with electric field

Source of internal field

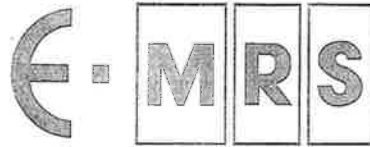


<http://photonics.intec.ugent.be> <http://www.nano.ugent.be>

Thank you

Acknowledgement
 The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement no.214954.





E-MRS 2011 Spring Meeting

Bilateral Energy Conference
Acropolis Congress Center
Nice, France

May 9 – 13, 2011



ICAM



www.european-mrs.com

- 10:45 Understanding Absorption Coefficient Anisotropy of Colloidal Quantum Rods
 Authors : Kamal John Sundar 1, Masoumeh Karvar 2, Raquel Gomes 2, Sien Compennolle 3, Frank Vanhaecke 3, Kristiaan Neyts 2, Zeger Hens 1
 1 Physics and Chemistry of Nanostructures, Ghent University, Krijgslaan 281-S3, 9000 Gent, Belgium 2 Liquid Crystals and Photonics, Ghent University, Sint-petersnieuwstraat 46, 9000 Gent, Belgium 3 Department of Analytical Chemistry, Ghent University, Krijgslaan 281-S12, 9000 Gent, Belgium 9
 2
 add to my program (view full abstract)
- 11:00 A Kramers-Krönig analysis of the absorbance spectrum of colloidal quantum dots: Calculation of the complex refractive index
 Authors : Iwan Moreels¹, Ludger Wirtz², Christophe Delerue² and Zeger Hens¹
 1. Physics and Chemistry of Nanostructures, Ghent University, Krijgslaan 281-S3, BE-9000 Ghent, Belgium. 9
 2. Institute for Electronics, Microelectronics, and Nanotechnology, CNRS-UMR 8520, FR-59652 Villeneuve d'Ascq, France. 3
 add to my program (view full abstract)
- 11:15 4-5 μm Continuous-Wave type I Lasers Operating Near Roomtemperature
 Authors : M. Eibelhuber, T. Schwarzl, S. Pichler, W. Heiss, G. Springholz
 Institute of Semiconductor and Solid State Physics, Johannes Kepler University Linz 9
 4
 add to my program (view full abstract)
- 11:30 Mid-infrared device applications of epitaxial PbTe quantum dots embedded in CdTe
 Authors : Astrid Hochreiner, Thomas Schwarzl, Martin Eibelhuber, Wolfgang Heiss, Gunther Springholz: Institute of Semiconductor Physics, University of Linz, Austria 9
 Valery Kolkovskiy, Grzegorz Karczewski, Tomasz Wojtowicz: Polish Academy of Sciences, Warszawa, Poland 5
 add to my program (view full abstract)
- 11:45 Stark effect on CdSe/CdS/ZnS colloidal quantum dots
 Authors : Sreeparvathi Warriar(1), Karel Lambert(2), Jolien Dendooven(3), Christophe Detavernier(3), Zeger Hens(2), Dries Van Thourhout(1) (1) Ghent University - IMEC, Department of Information Technology, Sint-Pietersnieuwstraat 41, 9000 Gent, Belgium. (2) Physics and Chemistry of Nanostructures, Ghent University, Belgium (3) Coating and Contacting of Nanostructures, Department of Solid State Sciences, Ghent University, Krijgslaan 281-S1, Gent, Belgium 9
 6
 add to my program (view full abstract)
- 12:00 Lunch
 ZnO nanoscale structures and device I : TBC
- 13:30 ZnO nanorods by solution growth for optoelectronic device applications
 Authors : Alan M. C. Ng 1, Xinyi Chen 1, Fang Fang 1, Aleksandra B. Djurišić 1*, Wai Kin Chan 2
 1 Dept. of Physics, the University of Hong Kong, Pokfulam Road, Hong Kong 10
 2 Dept. of Chemistry, the University of Hong Kong, Pokfulam Road, Hong Kong 1
 add to my program (view full abstract)
- 14:00 Optical investigation of a single ZnO nanowire: The test case of surface functionalization with organic C60 complexes.
 Authors : J. S. Reparaz¹, M. R. Wagner¹, G. Callsen¹, F. Güell², R. Kirste¹, J. R. Morante^{2,3}, A. Hoffmann¹, M. I. Alonso³, and A. R. Goñi
 1) Institut für Festkörperphysik, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany 2) Departament d'Electrònica, M-2E, IN2UB, Universitat de Barcelona, C/Martí Franqués 1, 08028 Barcelona, Catalunya, Spain 3) Institut de Recerca en Energia de Catalunya (IREC), C/Josep Pla 2, 08019 Barcelona, Catalunya, Spain 4) Institut de Ciència de Materials de Barcelona-CSIC, Esfera UAB, 08193 Bellaterra, Spain 10
 2
 add to my program (view full abstract)
- 14:15 Investigation of the local luminescence features of ZnO nanostructures via cathodoluminescence
 Authors : Volodymyr Khranovskyy*, Vasyl Lazorenko**, George Lashkarev**, G. Reza Yazdi*, Rositza Yakimova*
 *Department of Physics, Chemistry and Biology (IFM), Linköping University, 58183 Linköping, Sweden **Institute for Problems of Material Science, National Academy of Science of Ukraine, 03142 Kiev, Ukraine 10
 3
 add to my program (view full abstract)
- 14:30 White light emitting devices based on nanoparticle multilayers
 Authors : E. Neshataeva, P. Felbier, T. Kümmell, G. Bacher
 Werkstoffe der Elektrotechnik und CeNIDE, Universität Duisburg-Essen, 47057 Duisburg, Germany 10
 4
 add to my program (view full abstract)