Silicon compatible laser based on colloidal quantum dots

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A cheap, reliable and robust light source integrated on silicon is often identified as a major missing link in silicon photonics research. A few options already exist, such as the continuous wave silicon Raman laser or a heterogeneously integrated III-V microdisk laser on silicon, but all have major drawbacks, like complex processing and weak temperature robustness. We are using a different approach by depositing colloidal quantum dots, produced in suspension through wet chemical synthesis. These quantum dots have a very efficient photoluminescence and can be tuned to a specific emission wavelength by controlling their size. The synthesis of these IV-VI nanocrystals (PbSe, PbS, PbTe) is being perfected at the Physics and Chemistry of Nanostructures Group (PCN) and will be adapted to a core/shell PbX/CdX (X=S, Se, Te) quantum dot synthesis to improve long term photoluminescence stability in films exposed to air.

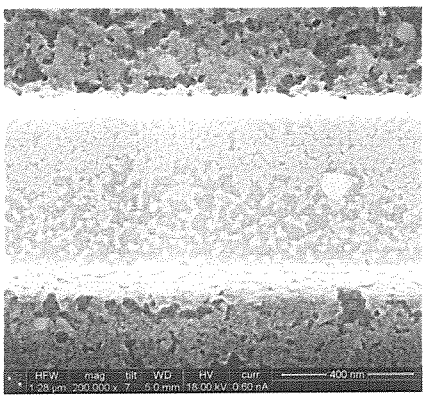

Figure 1: Photonic wire with spincoated nanocrystals on top and on the side

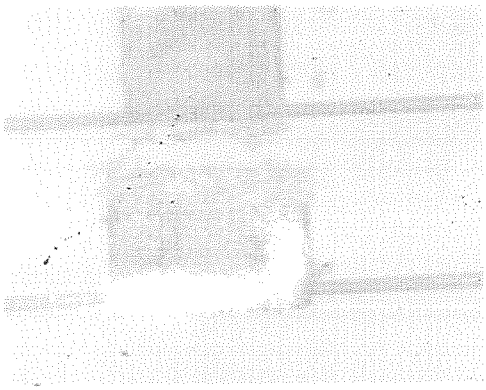

Figure 2: Spiral with nanocrystal overlay, suffering from scattering

The films can be deposited through langmuir-blodgett monolayer deposition, dropcasting or spincoating. Deposition and processing is hence extremely easy. The quantum dots can be deposited very locally by UV-contact lithography. Experiments indicate spincoating to be the preferred deposition method, because of its simplicity and ability to form uniform films of desired thickness. Further improvements need to be made to increase uniformity and decrease scattering at the film interface. Polymer films doped with colloidal quantum dots are being investigated as a possible solution. First tests show a modest coupling of the photoluminescent light to the SOI waveguides below the quantum dot film, indicating that luminescence is still present after deposition and luminescent light can be coupled to a photonic waveguide. The luminescence properties of different films are being investigated more thoroughly, in parallel with more coupling and interaction experiments on SOI photonic waveguides

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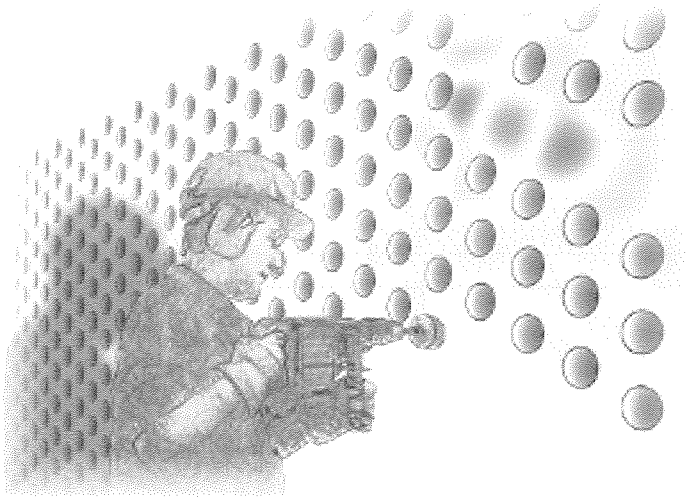
11 TO 17 MAY 2008



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Abstracts of Posters

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1. **V-Groove approach for inverted taper coupling in silicon photonics**: J. V. Galán
2. **Experimental Study of the Non-Linear Dynamics of Quantum-Dot InAs/InGaAsP/InP (100) Twin-Stripe Lasers Emitting at 1.5µm**: Jose Pozo
3. **InGaAs-InAlGaAs Monolithically Integrated Temporal Phase Coded OCDMA Encoder/Decoder**: S. McMaster
4. **A spectrally resolved study of quantum dot lasers**: G.A.P. Thé
5. **Carrier Transport Effects in Multi Layer Quantum Dot Lasers**: M. Rossetti
6. **Membrane couplers for optical interconnections on CMOS ICs**: A. Morant
7. **Optical Losses in Photonic Crystal Waveguides, Induced by Contact Strips for Electrical Pumping**: Peter Kaspar
8. **Measuring the Time-of-Flight with an optical MEMS-modulator**: Joris Roels
9. **InP-membrane based photodetector for optical interconnections on Si**: P.R.A. Binetti
10. **High bandwidth InP-based 1.55 µm waveguide photodetector fabricated in an amplifier layer stack with active-passive integration**: L. Xu
11. **Design and simulation of movable micromirrors on silicon substrate**: Comanescu Florin Constantin
12. **Fabrication of polymer-based devices using nanoimprint technology**, Jie Teng
13. **Liquid crystal technology for wavelength tuning in SOI structures**: Wout De Cort
14. **Photonic Reservoir Computing: interconnected Semiconductor Optical Amplifiers**: Kristof Vandoorne
15. **Waveguide – grating photonic system analysis for sensor applications**: Roxana Ileana Rebigan
16. **Design Of A Monolithically Integrated All-Optical Label Swapper For Spectral Amplitude Code Labels Using Cross-Gain Modulation**: Christian Habib
17. **Combined Technologies: Photolithography and Electron Beam Lithography for RF Filters on GaN Development**: Herghelegiu Alexandru
18. **Deep dry-etched single-mode narrow waveguide for all-optical switches with InGaAs/AlAsSb quantum wells**: Ping Ma
19. **Assessment of mesh-interconnected integrated photonic switch circuits**: Aaron Albores Mejia
20. **SOI-based couplers for the transition from DPSK- to DQPSK-demodulators**: Karsten Voigt
21. **Adjustment of birefringence on Silicon-on-Insulator (SOI) by mechanical bending**: Georg Winzer
22. **Analysis of thermal crosstalk between DFB-laserdiodes on SOI**: B. Wohlfeil
23. **Towards optimization of Raman effect in SOI rib waveguides – compromise between linear loss and carrier lifetime**: Andrzej Gajda
24. **Bragg Gratings on SOI Rib Waveguides - A Comparison of Different Geometries**: Ivano Giuntoni
25. **Slow Light in Chalcogenide Photonic Crystals**: Marcel Spurny

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28. **Silicon optical modulator:** Fengqiao Dong
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31. **InP Photonic Crystals bonded to SOI wires:** Yacine Halioua & Tim Karle
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46. **Photonic crystal waveguides with ring-shaped holes on silicon-on-insulator:** A. Säynätjoki
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48. **Quantum Confined Stark Effect (QCSE) Tuned Lasers:** Francesca Pozzi
49. **Multi-waveguide based collector array for the detection of backscattered light from highly scattering media:** N. Ismail
50. **Continuous wave InGaAsP/InP Fabry-Perot lasers on silicon:** Tiphaine Dupont