NAVOLCHI

SEVENTH FRAMEWORK PROGRAMME

Unit of Materials and Optoelectronic Devices

University of Valencia

www.uv.es/umdo

ICMUV INSTITUT DE CIÈNCIA DELS MATERIALS de la Universitat de València

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Current State of the work

Eindhoven January 28th 2014

Outline

1-Current Status of the work

1.1-Plasmonic amplifiers by using polymers doped with QDs

1.2-Photodetectors based on QDs and polymers

2- Next steps and collaborations with other partners

3-Reports

3.1-Deliverables

3.2-Milestones

3.3-Dissemination

Plasmonics amplifiers

Previous (to the review meeting in Brusels)

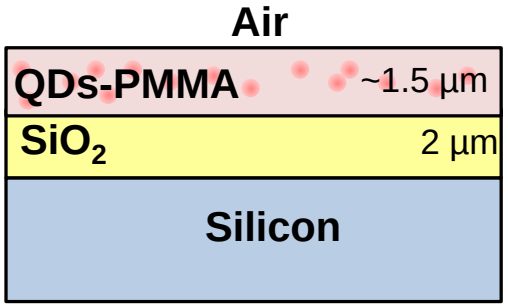
- Design of plasmonic amplifiers
- Active properties of CdSe QDs, PbS QRs

Last months

- HgTe as an active material
- 2D plasmonic waveguides
- Propagation length in plasmonic waveguides

Plasmonics amplifiers

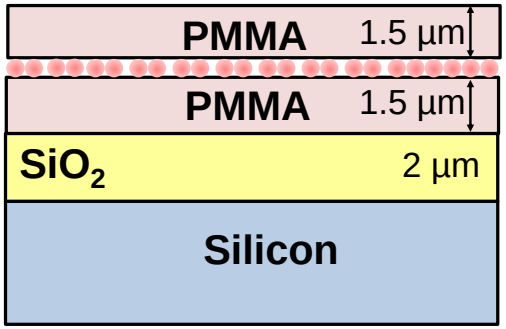
Active HgTe waveguides



Filling factor (*ff*) implies a trade-off between absorption losses and generated photoluminescence (**PL**)

↓

Pump from the surface



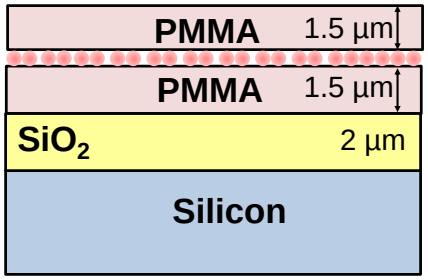
This configuration can solve this trade-off by finding optimal thicknesses

➔High amount of waveguided PL

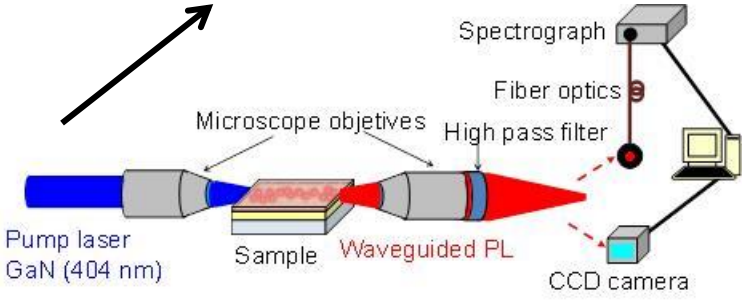
➔ not net amplification yet

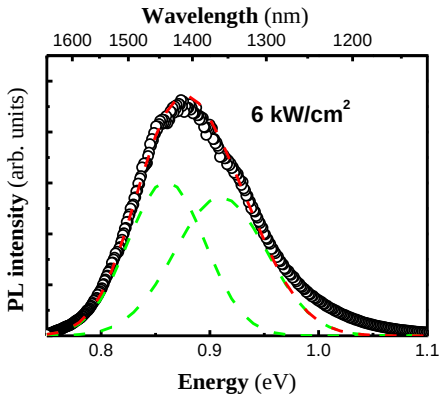
Plasmonics amplifiers

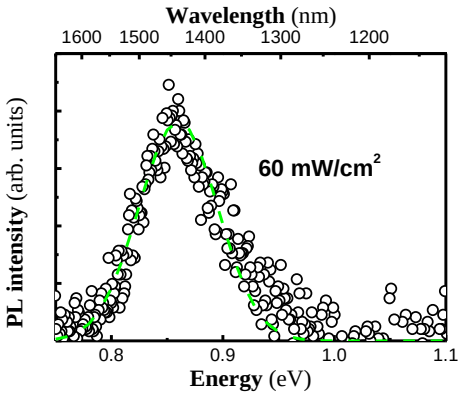
Active HgTe waveguides

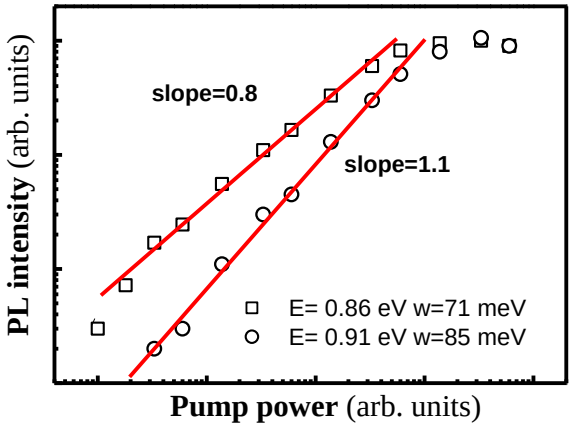


CW 450 nm and 533 nm Nd:Yag laser







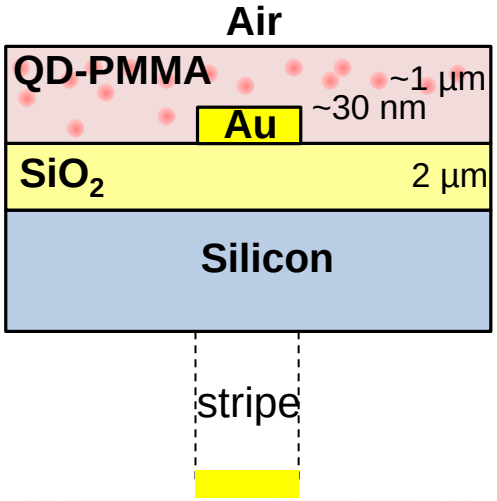


g_0~300 cm^{-1}

α~20 cm^{-1}

Plasmonics amplifiers

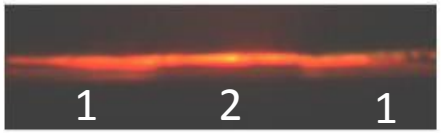
2D Plasmonic waveguides



- Au stripes (~10 µm) by UV lift-off process
- Covered by active material

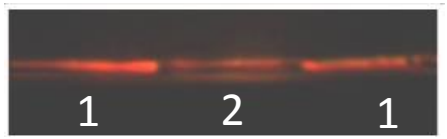
Near field characterization:

TE



1) **Photonic** TE mode on the dielectric
2) **Photonic** TE mode on the metal

TM

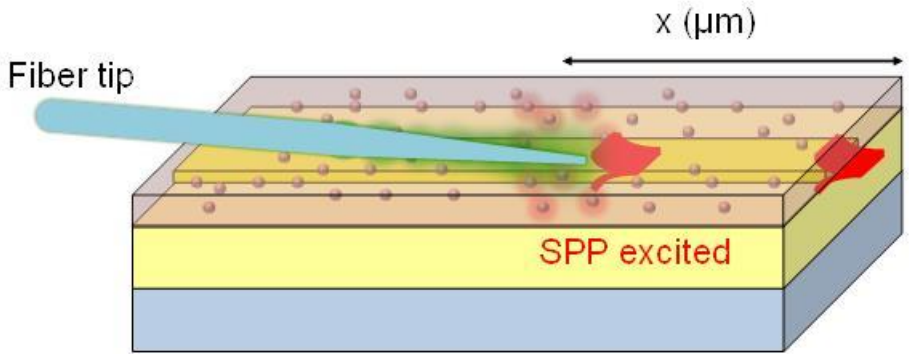


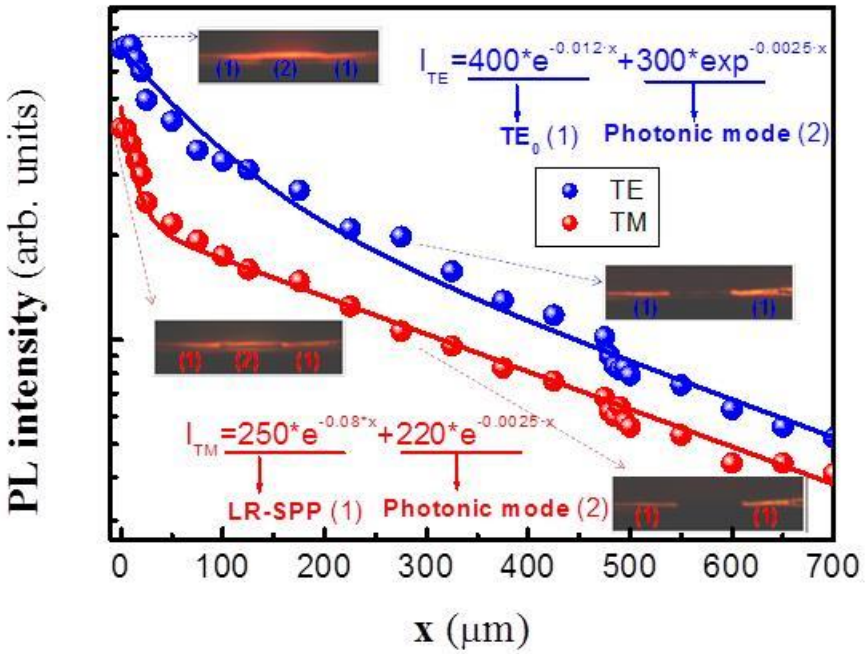
1) **Photonic** TM mode on the dielectric
2) **Plasmonic** TM mode on the metal

Plasmonics amplifiers

Plasmonic waveguides

Method to characterize Propagation length:





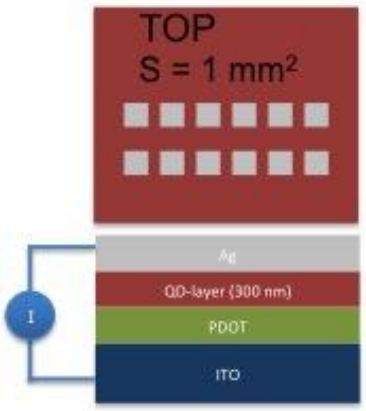
LR-SPP L_p=12.5 μm, close to the theoretical (11 μm)

Photodetectors

Milestone 23

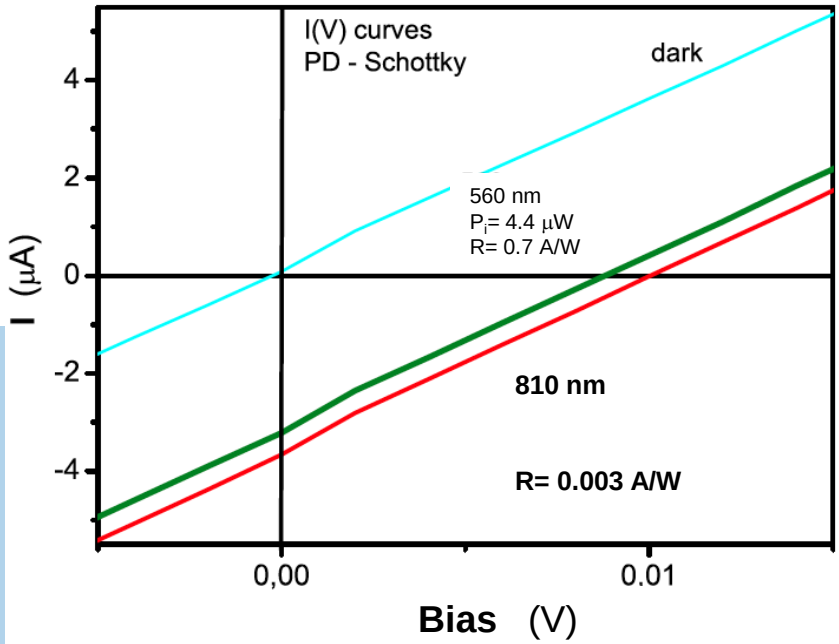
Current tasks:

- **Enhancement of Responsivity at near-IR of QD-Schottky PD**
- **Nanogap design under fabrication**.
- **Photomask for fabricating microgap contacts ordered.**



- Dr. Blade deposition is being used for 200-500 nm thickness of layers, but still needing further work for optimization.
- Better results are obtained: larger resistivity layers and hence lower reverse bias losses in Schottky diodes. Responsivity and Voc 10x more at 820 nm.

Before (spin-coating)



Photodetectors

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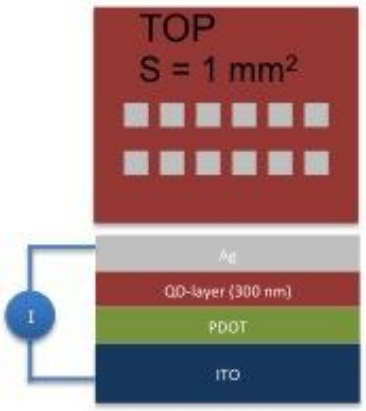

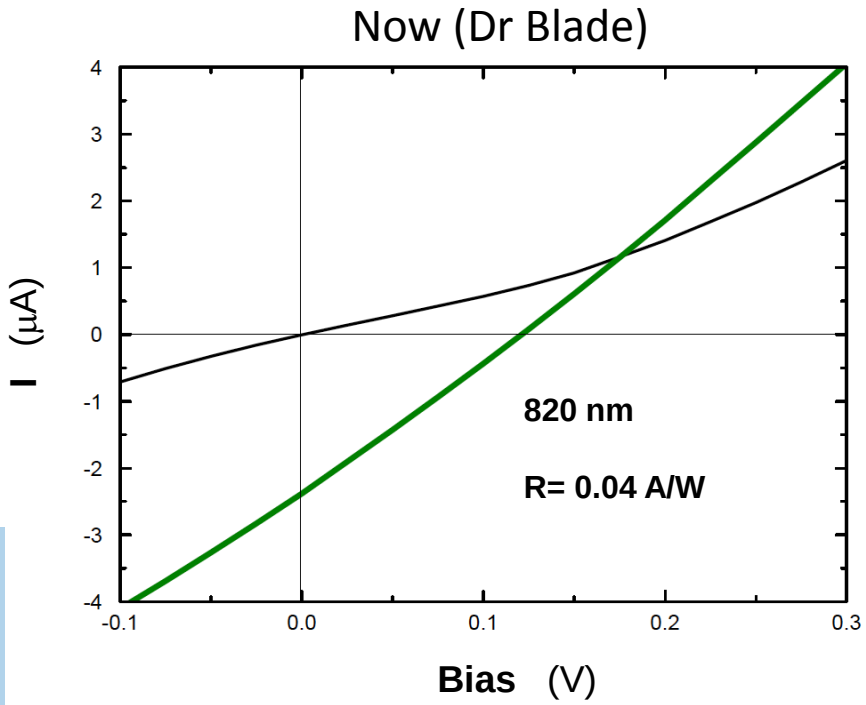

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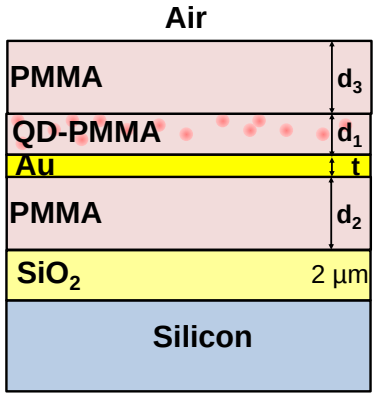
Next steps and collaborations

Gain in HgTe QDs

- Improve excitation
- Report sent to to UGENT➔New samples from UGENT

Plasmonic waveguides

- Propagation length in optimized structures (1D or 2D)
- Set-up to include pumping
- Samples with HgTe QDs



Photodetector

- Nanogap➔ In contact with Victor

Deliverables and Milestones

	Names of the Milestones	Month	Partner
MS16	Decision on optimized structures for plasmonic amplifiers	12	UVEG
MS17	Synthesis of nanoparticles with gain at 1550nm	12	UGENT
MS18	Demonstration of conductive QD layers with photoconductive properties	15	UVEG
MS19	Demonstration of metal-(lithographic) polymer and QD metal-(lithographic) polymer nanocompo-sites	15	UVEG
MS20	Demonstration and decision on photodetector operation: nano-gap (MIM) vs. Schottky / heterostructure	18	UVEG
MS22	Demonstration of plasmonic amplifiers with optical pumping exhibiting 10 dB gain	21	IMEC
MS23	Operation of QD based photodetector with responsivity > 0.1 A/W	24	UVEG
MS24	Demonstration of SPP amplifiers with electrical injection exhibiting 10dB/cm gain	30	UVEG

Deliverables and Milestones

	Names of the Deliverables	Month	Partner
D4.1	Designs of plasmonic amplifiers	18	UVEG
D4.2	Report on optical properties of QDs layers and polymer nanocomposites	18	UVEG
D4.3	Designs of plasmonic photodetectors	24	UVEG
D4.4	Report on SPP amplifiers by using QDs	30	IMEC
D4.5	Report on plasmonic photodetectors	33	UVEG
D.7.1	First report on NAVOLCHI dissemination and promotion activities	18	AIT
D.7.2	First report on NAVOLCHI exploitation activities	18	AIT

Dissemination

- Invited talk at ICTON: **Will there be Navolchi session?**