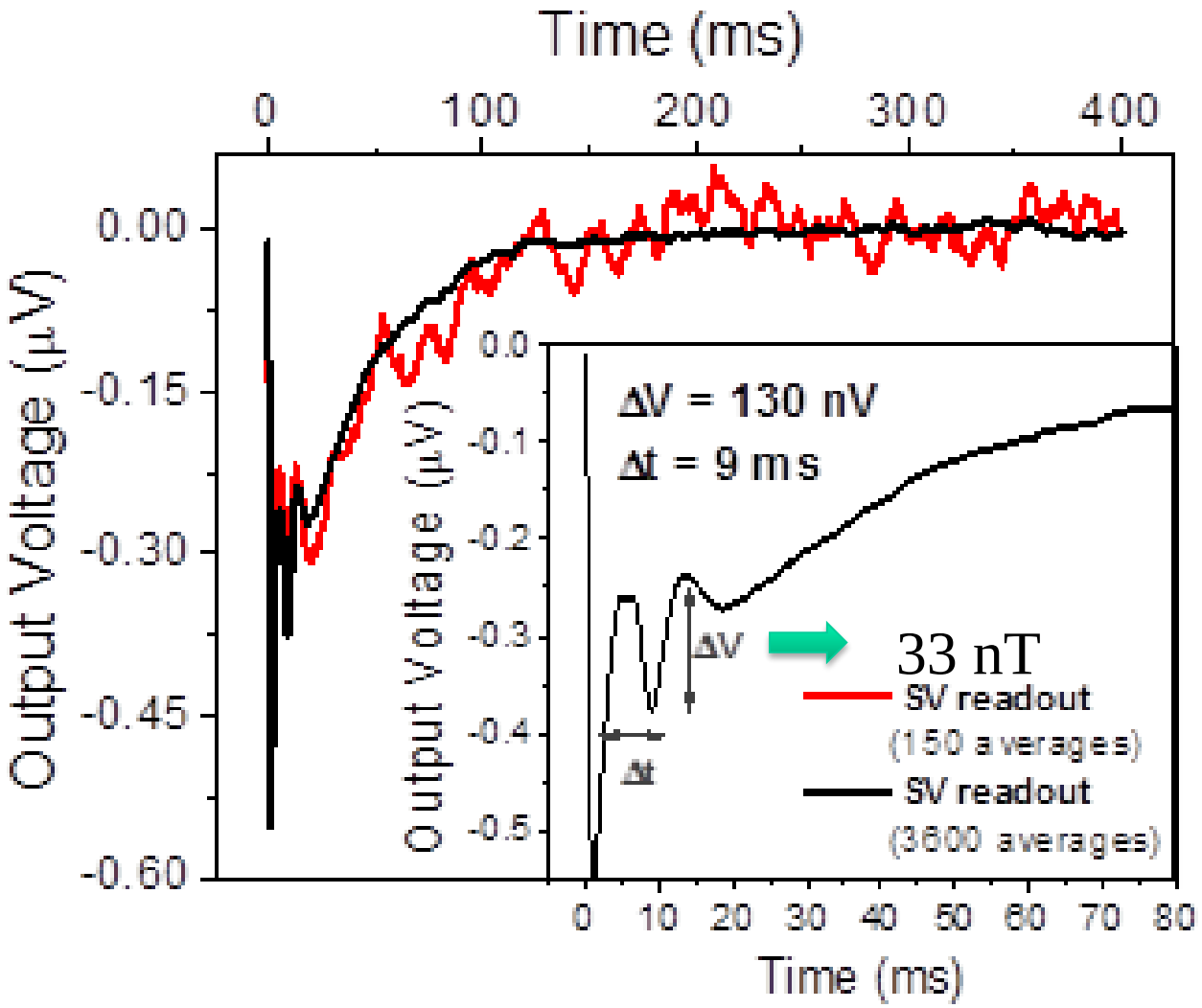
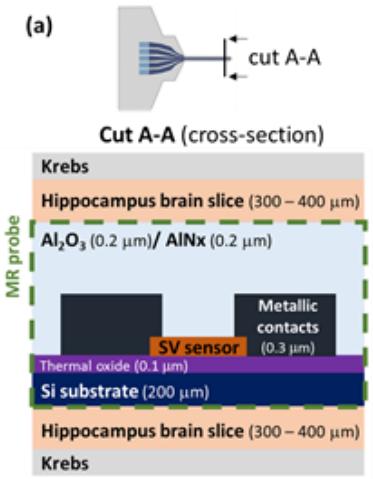
INESC MN

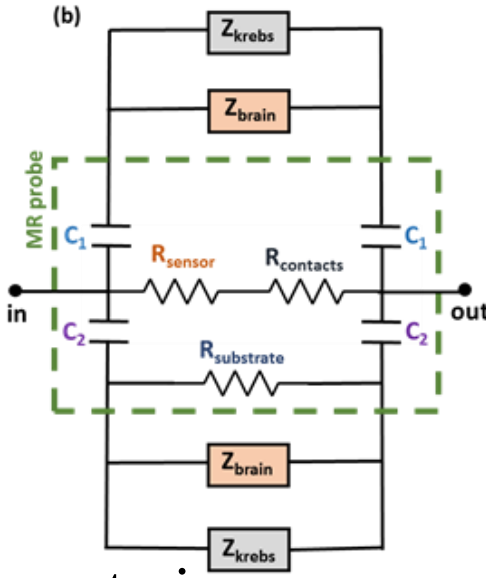
Sensor response to electrical stimulii

IMM

INL INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

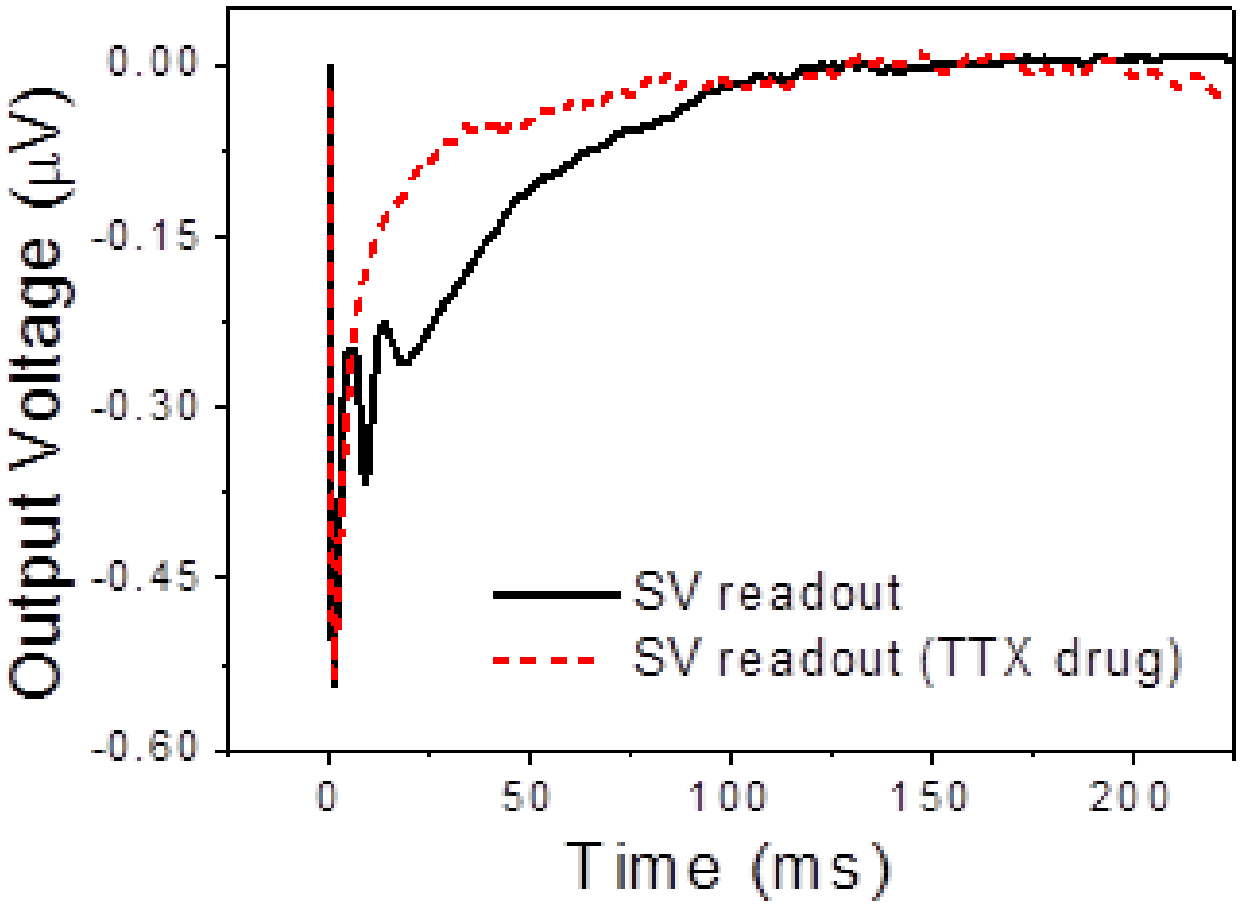


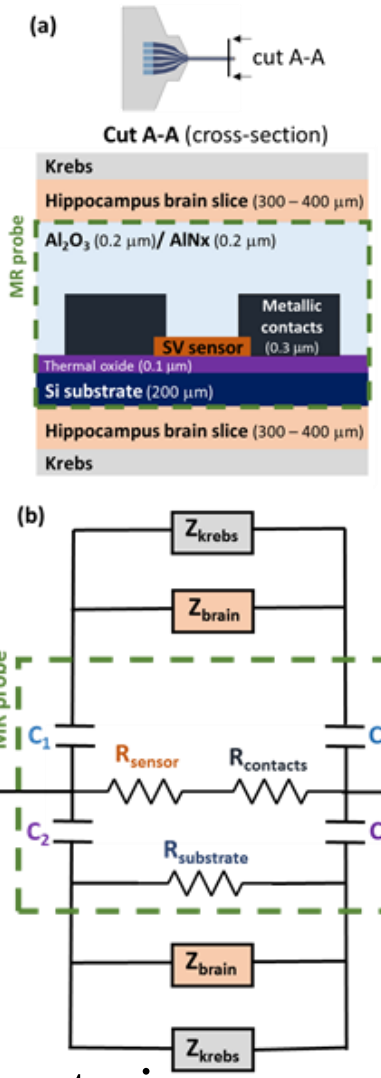




IEEE Trans on Instrumentation and Measurement : in press

Sensor response to electrical stimulii

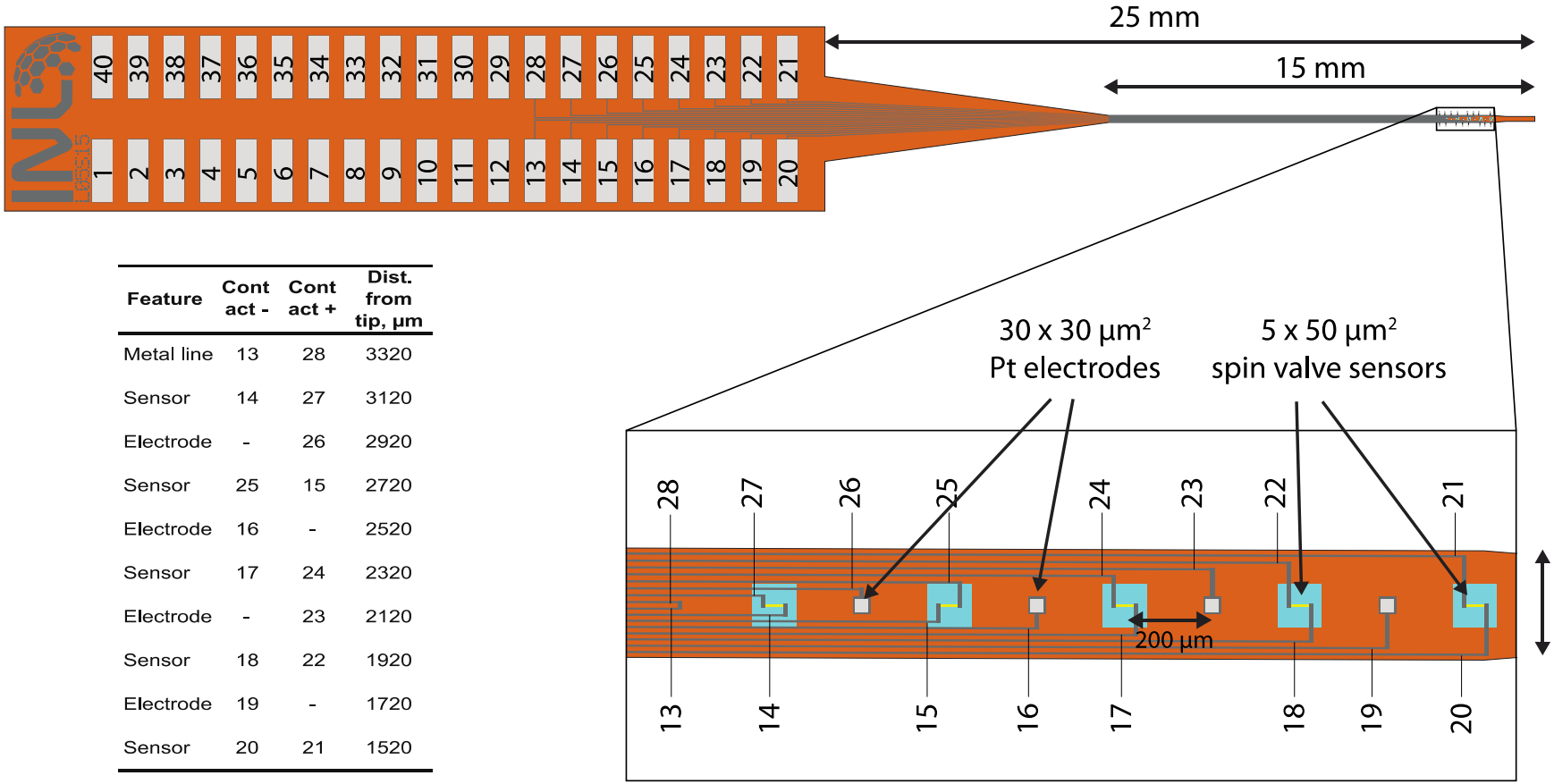




IEEE Trans on Instrumentation and Measurement : in press

Flexible microelectrodes

Pads size/pitch designed for Harwin 2-row, 40-way vertical connector

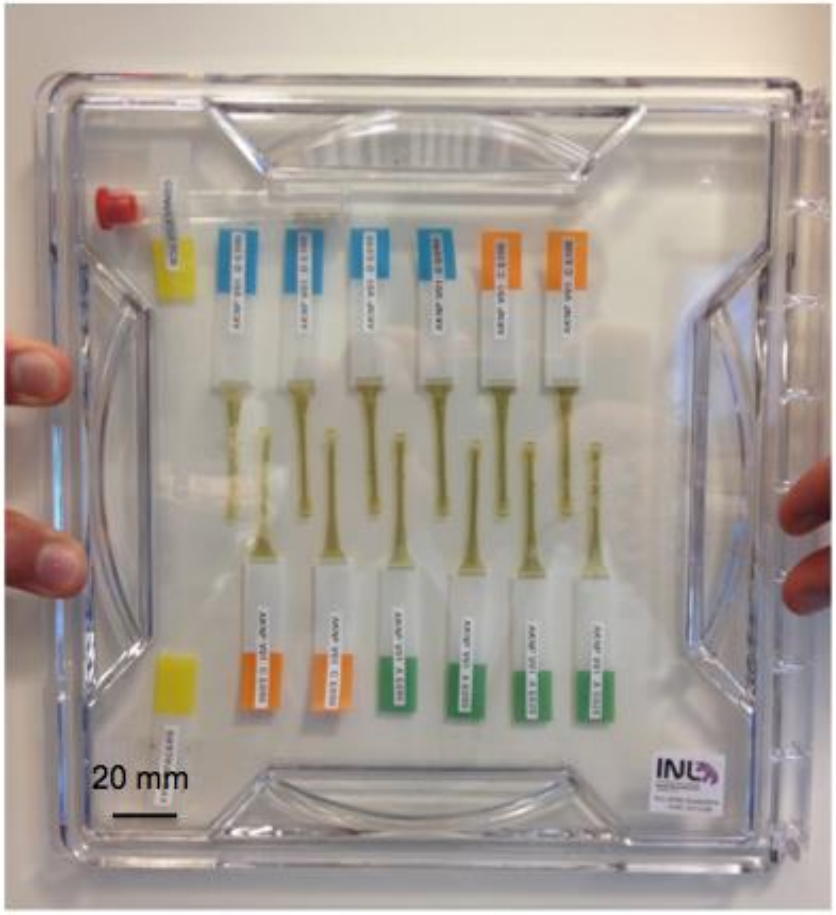


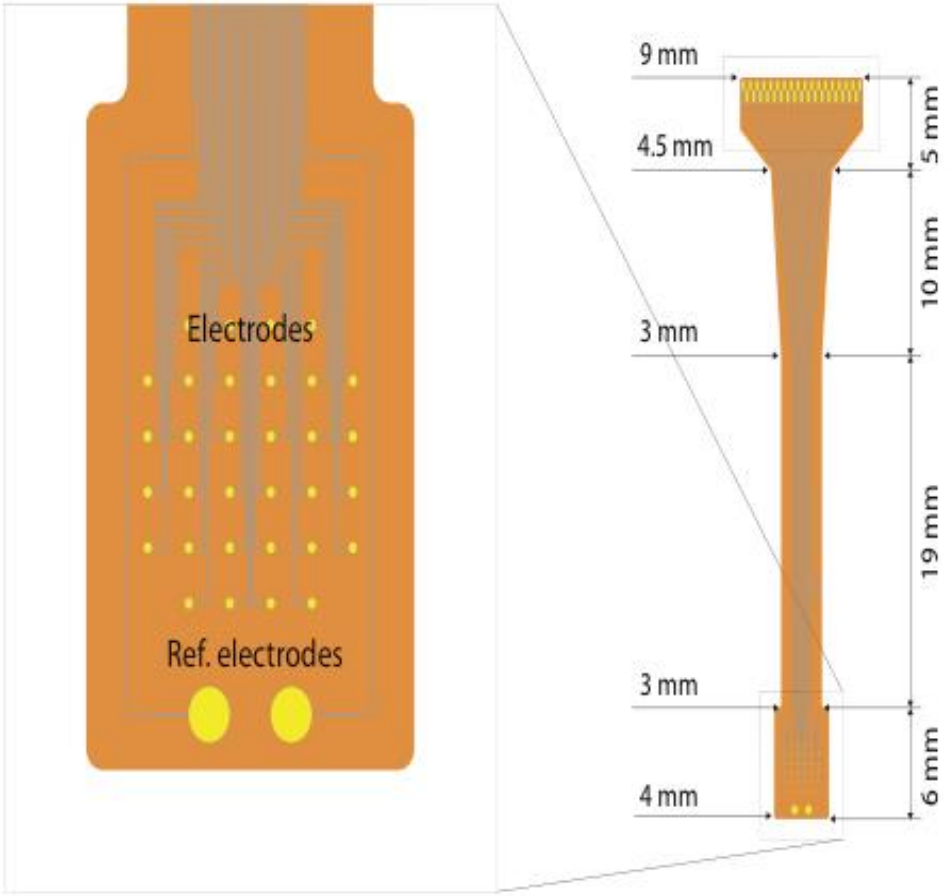
Feature	Cont act -	Cont act +	Dist. from tip, µm
Metal line	13	28	3320
Sensor	14	27	3120
Electrode	-	26	2920
Sensor	25	15	2720
Electrode	16	-	2520
Sensor	17	24	2320
Electrode	-	23	2120
Sensor	18	22	1920
Electrode	19	-	1720
Sensor	20	21	1520

J.Gaspar, J.Noh, INL

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

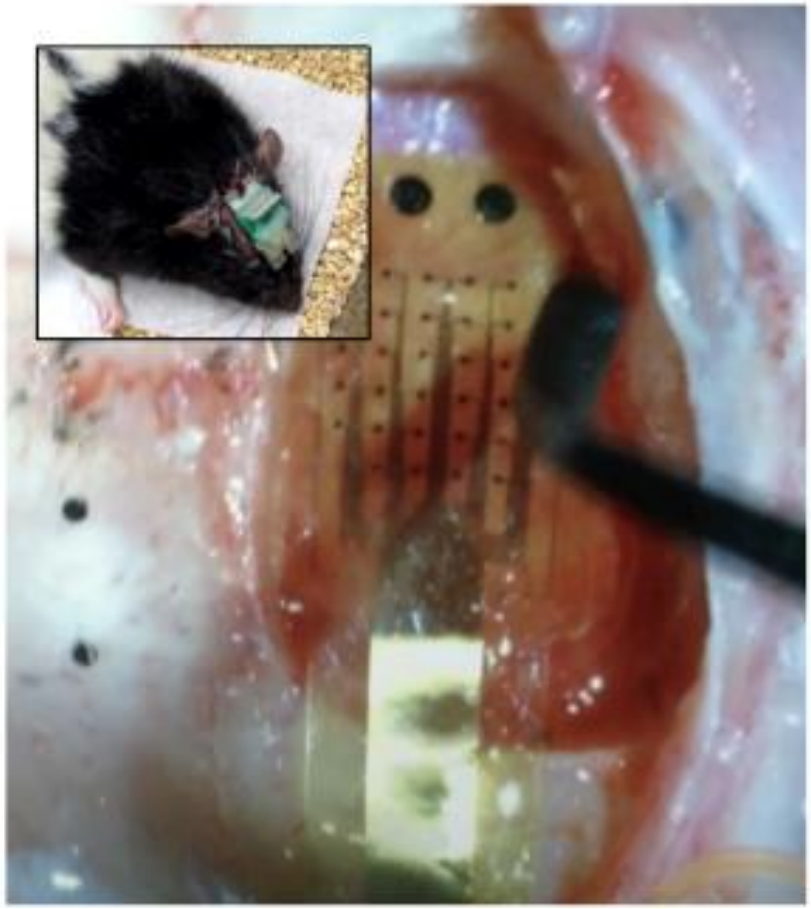
Flexible Grid Electrodes

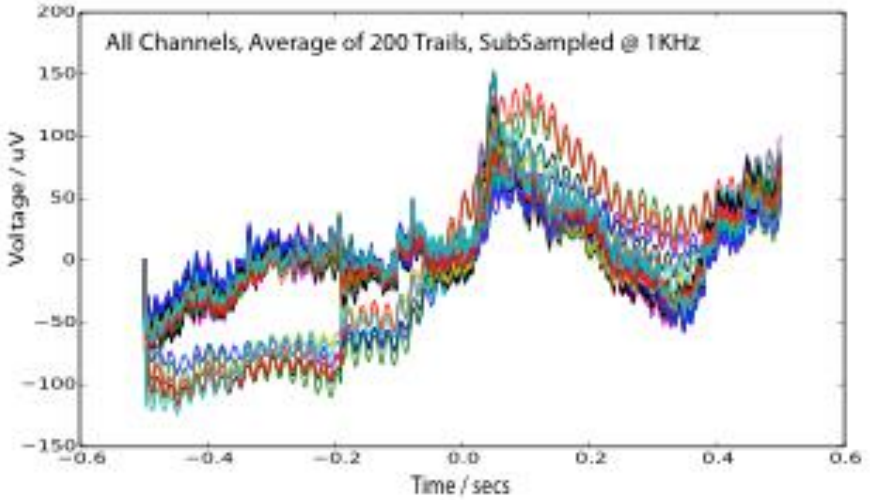


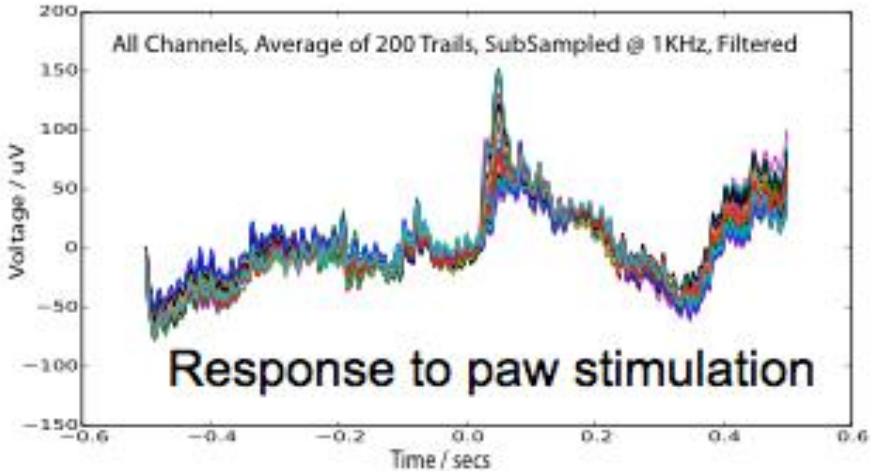


INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

Flexible Grid Electrodes







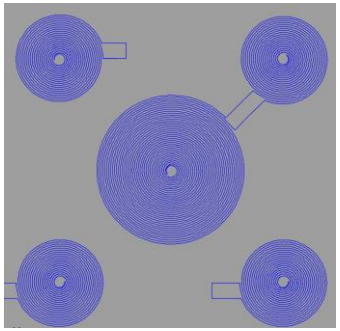
J.Gaspar, INL

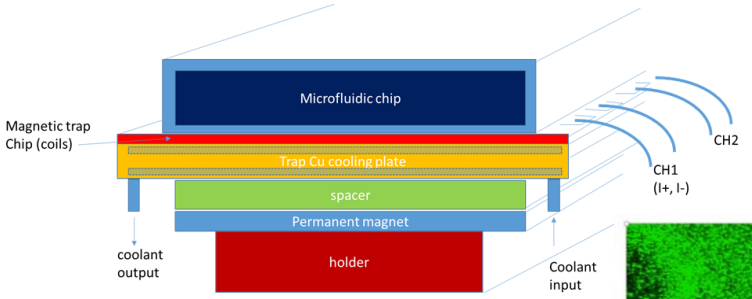
Collaboration with E.Champalimaud

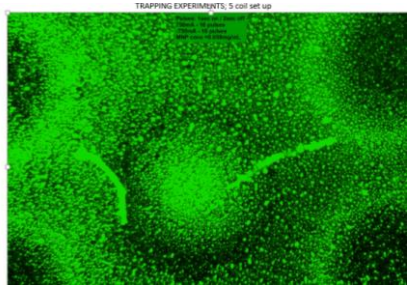
Fine-tuning the manipulation of magnetically labelled bio-analytes by thin film micro-electromagnet traps

P.P.Freitas [2,1], M.Amaral [3] , V.Silverio [1], M.Lopez-Martinez [1], S.Cardoso [1] J.Gaspar [2], H. Fonseca [2], M. Brito [2]

1-INESC MN and IST, Lisbon , Portugal
2-INL, Braga, Portugal
3-FCUP, Porto, Portugal







HOW DOES MAGNETIC TRAPPING WORKS

$$\mathbf{F} = \nabla (\mathbf{m} \cdot \mathbf{B})$$

Use two B sources: B_1, B_2

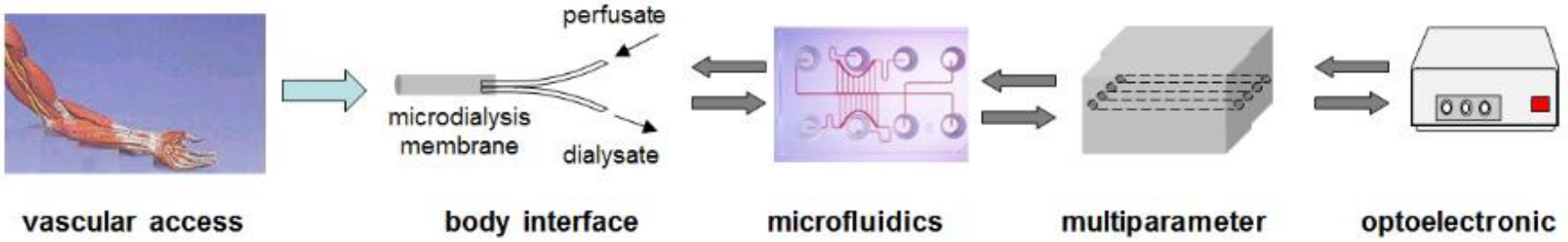
One to create local B gradient (coil, line) B_1- large gradient

One to magnetize particles (if possible close to saturation) B_2- small gradient
$\nabla B_2 < \nabla B_1$

$$\mathbf{F} = \nabla [\mathbf{m} (\mathbf{B_2}) \cdot (\mathbf{B_1}+\mathbf{B_2})]$$

Immunosuppressant assay requirements

immunosuppressant	LoD in whole blood	LoD in Nanodem
Tacrolimus	0.5 ng / mL	0.5 pg / mL
mycophenolic acid	0.2 µg / mL	0.2 ng / mL
cyclosporin A	20 ng/ml	20 pg/ml
Sirolimus	1 ng / mL	1 pg / mL
Everolimus	0.5 ng / mL	0.5 pg / mL



-Labelling free protein With fluorescent/magnetic nano-articles
-PM magnetic separation

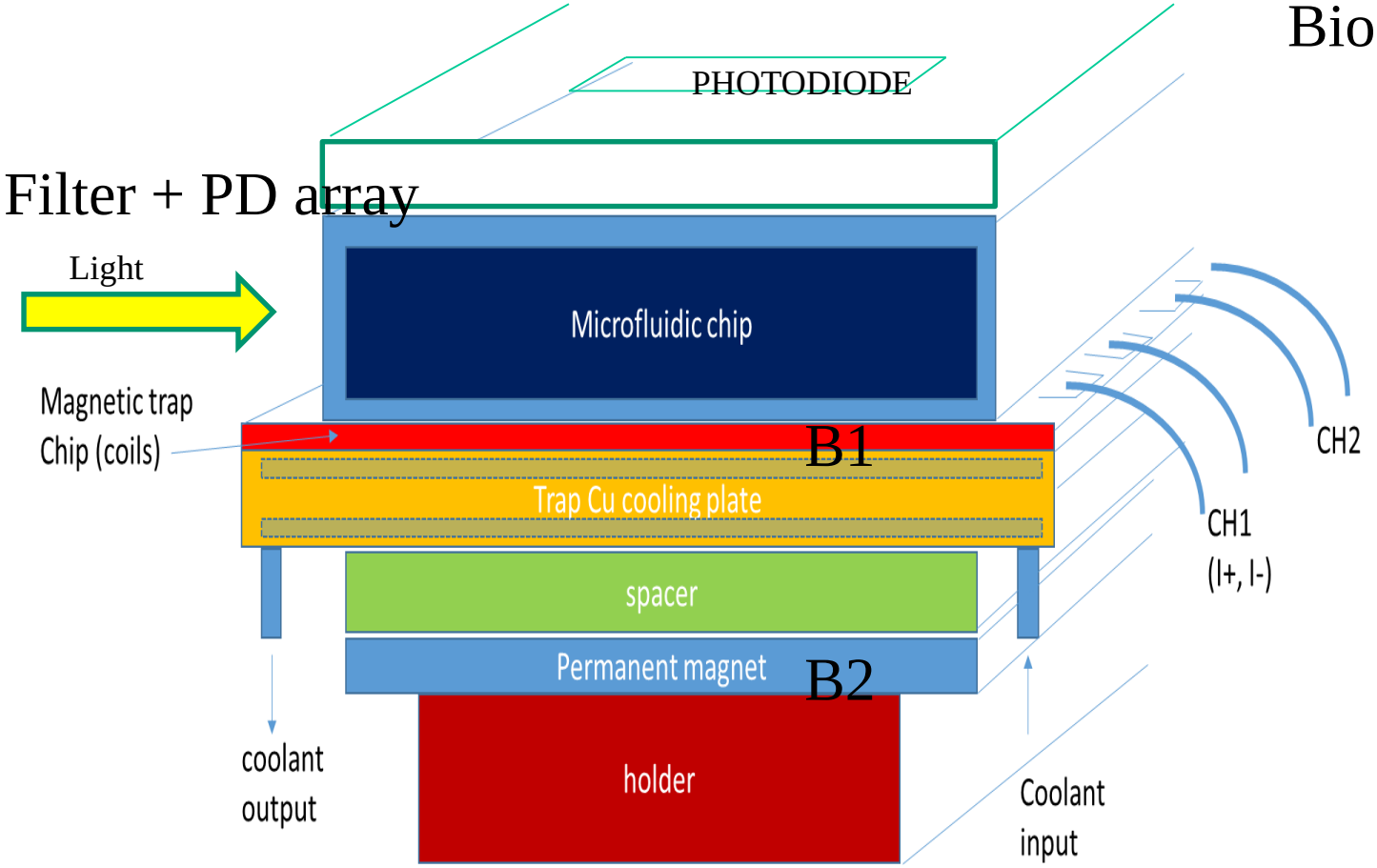
-Magnetic traps (attract+repel)
-Photodiodes
-Microfluidics II

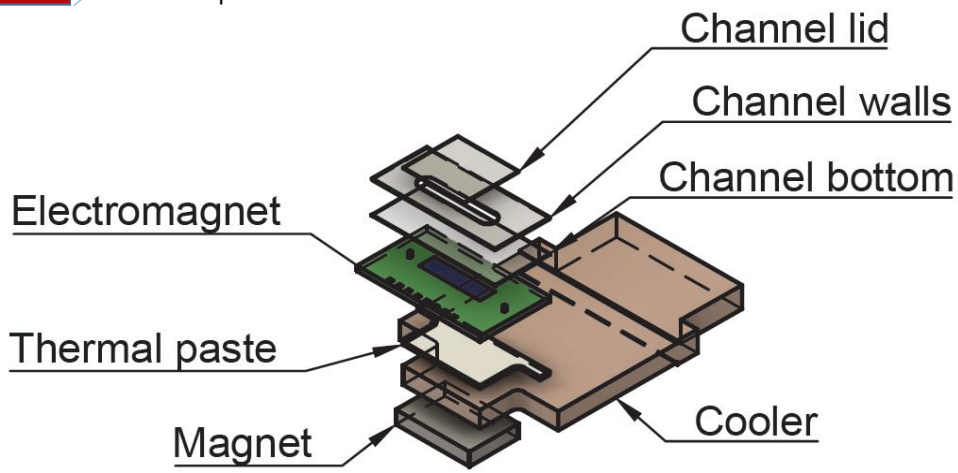
http://nanodem.ifac.cnr.it/

SEVENTH FRAMEWORK PROGRAMME

NANODEM

Biosensing Chip La



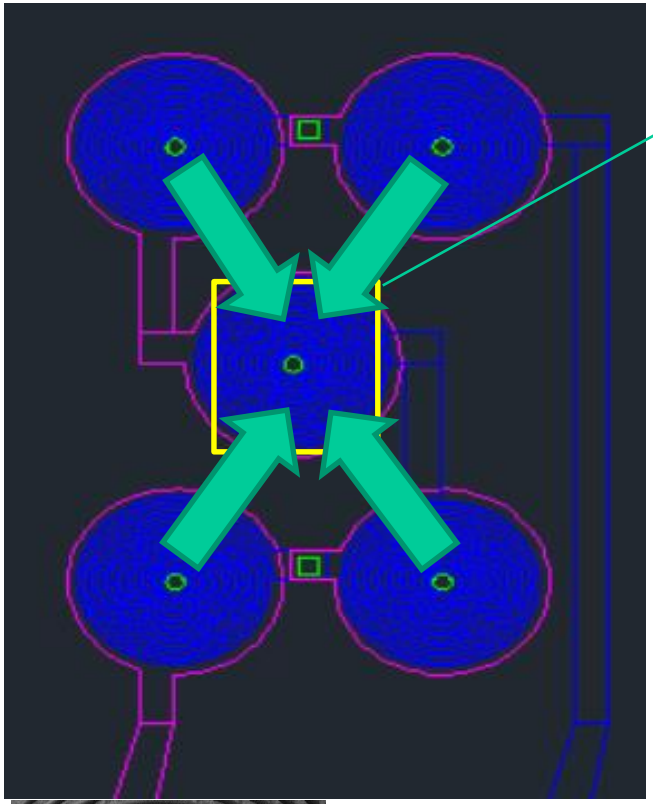


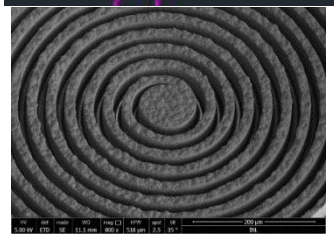
MAGNETIC TRAP GEOMETRY

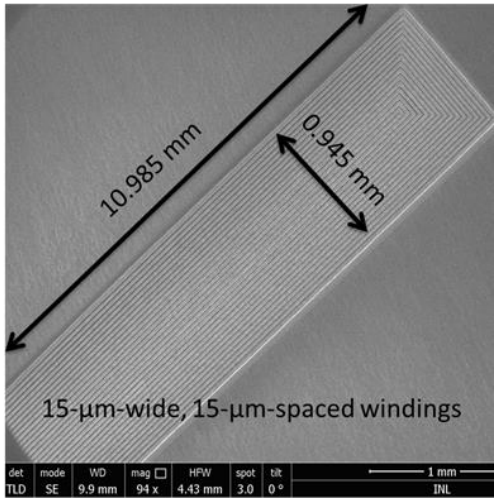
Mag Trap in contact with microfluidic chip
10 channels, 1 photodiode per channel

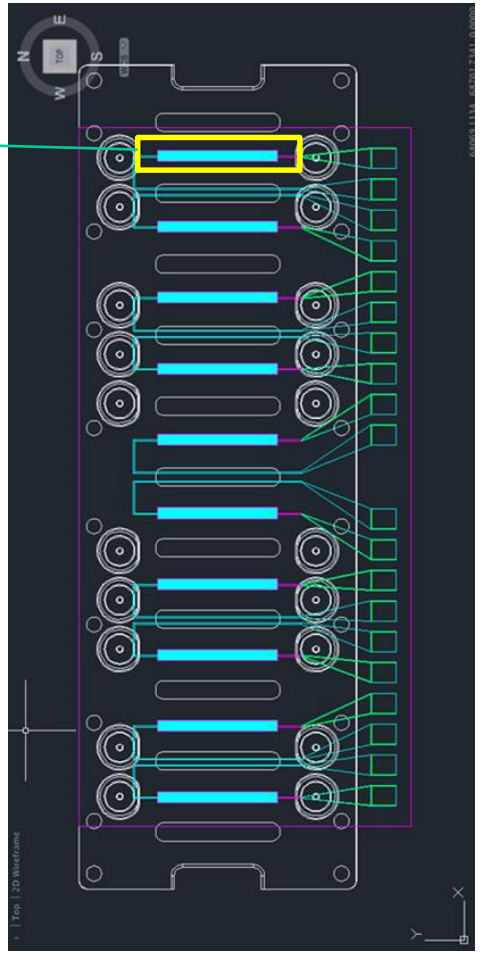
Mag Trap Chip in conatct with fluid (inside microfluidic chamber)
1 photodiode centered over the central coil

PHOTODIODE

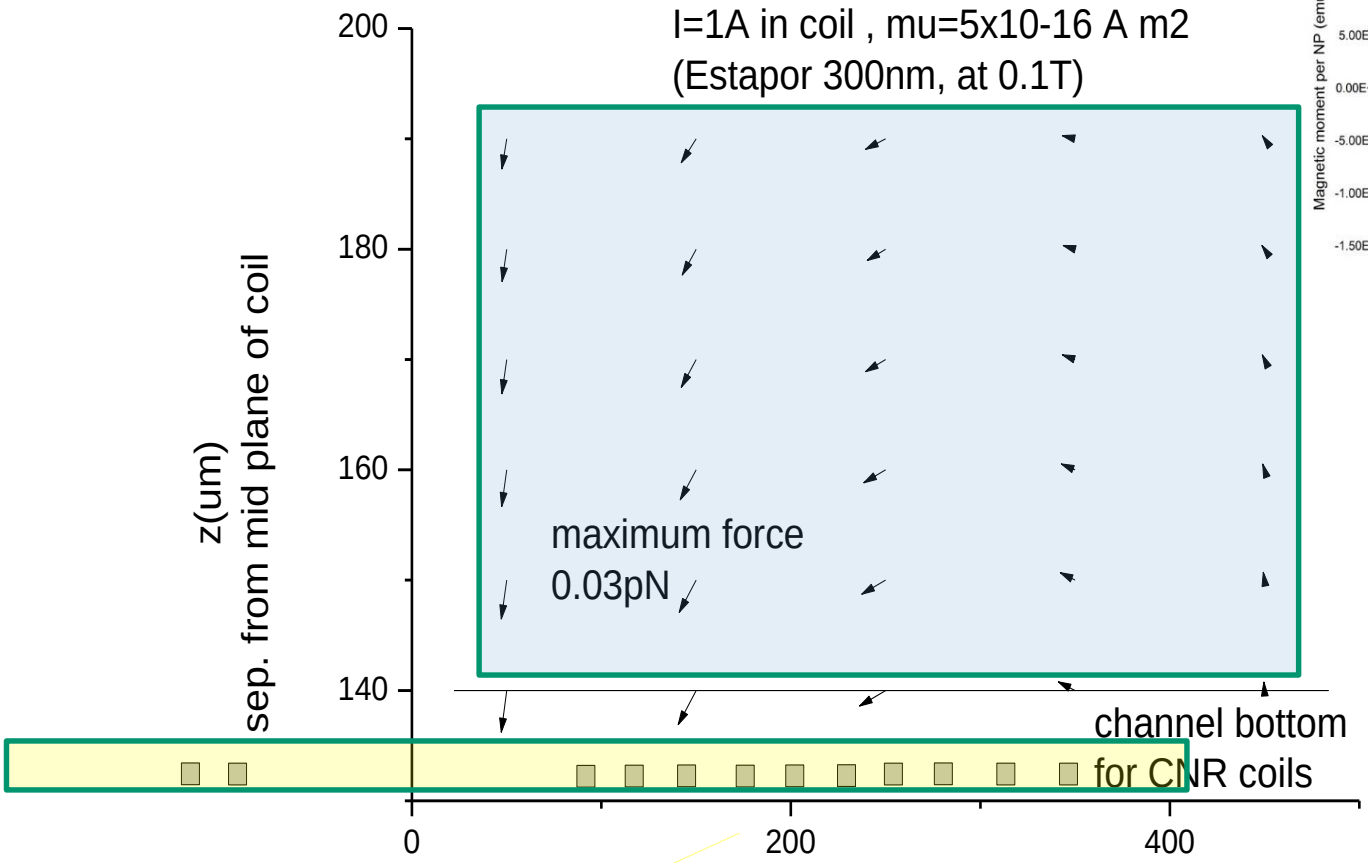


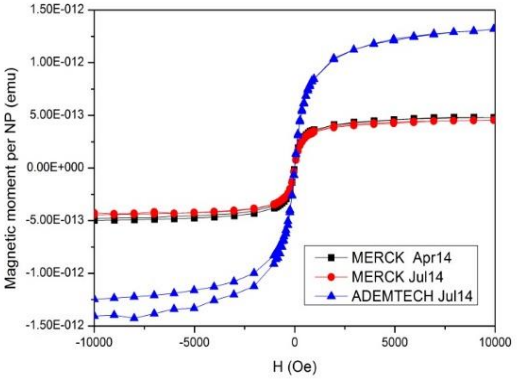






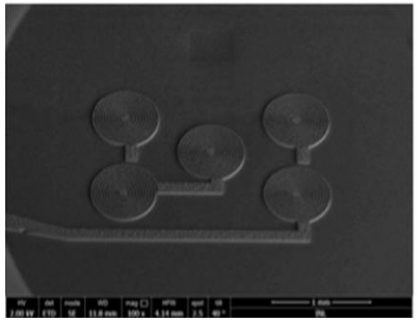
Calculting the magnetic force on the MNPs for circular coils

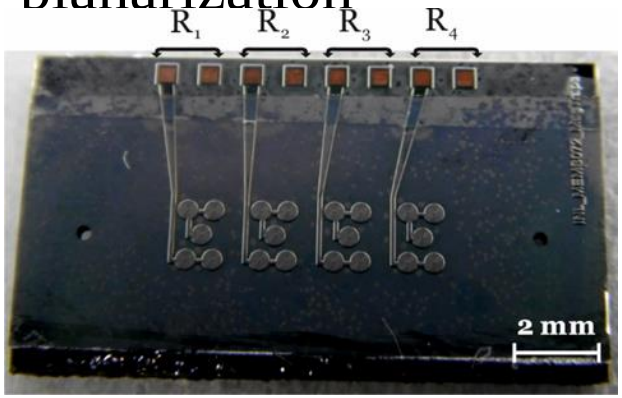




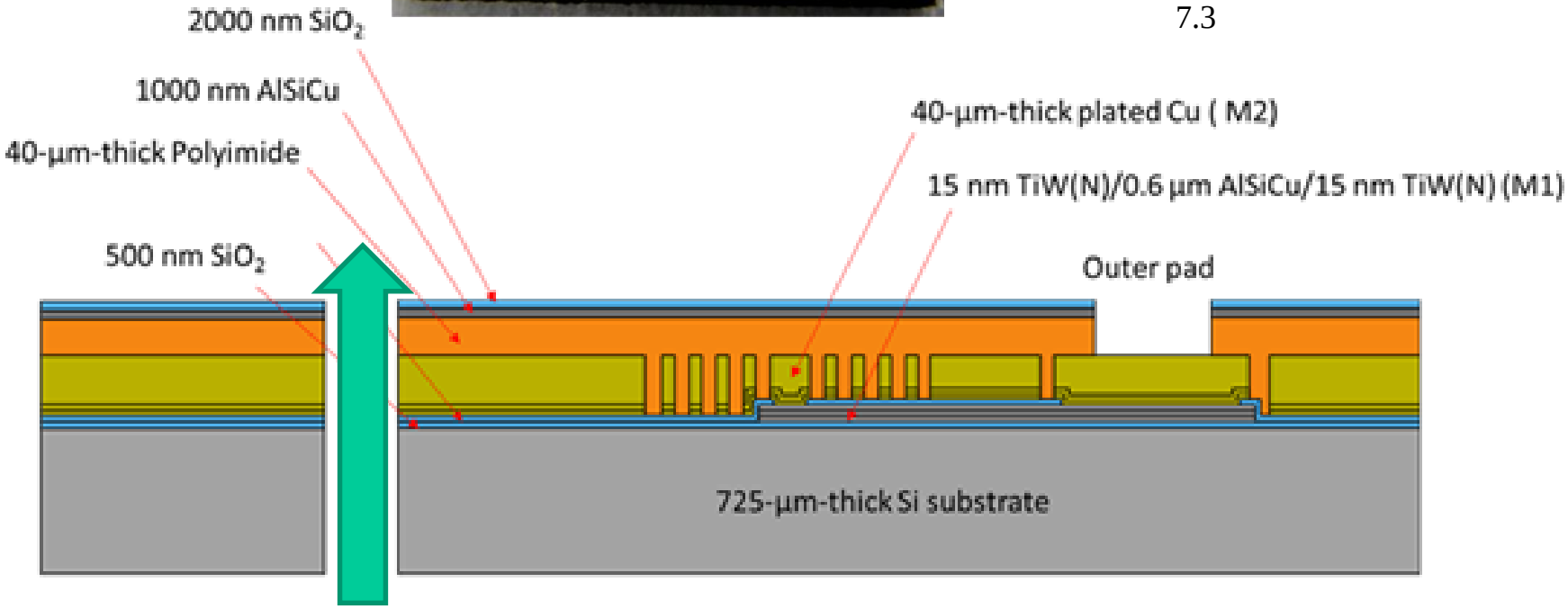
MNP with added
Bodipy fluorophores

4th generation planaized Cu coils: Cu, Polyimide planarization





	Chip I	Chip II	Chip III	Chip IV
R1 (Ω)	7.7	8.3	8.4	7.8
R2 (Ω)	8.3	8.8	8.3	7.8
R3 (Ω)	8.4	8.7	7.1	7.7
R4 (Ω)	8.1	8.5	7.1	7.3



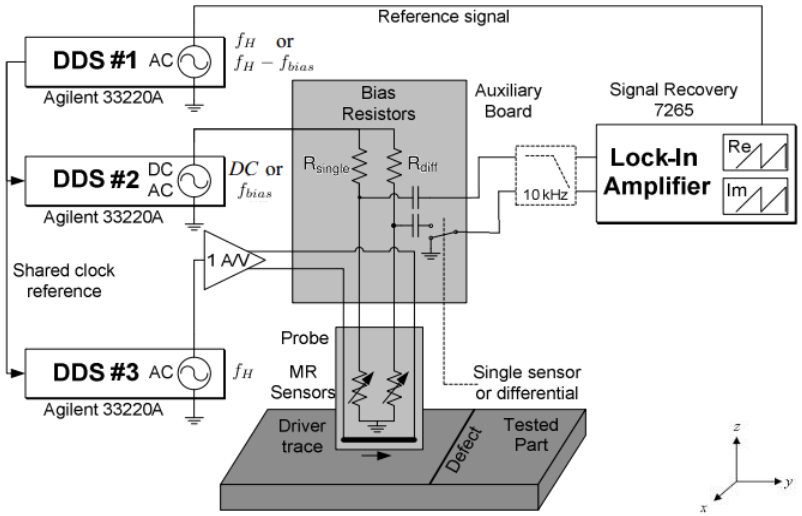
Fluid input through Si via

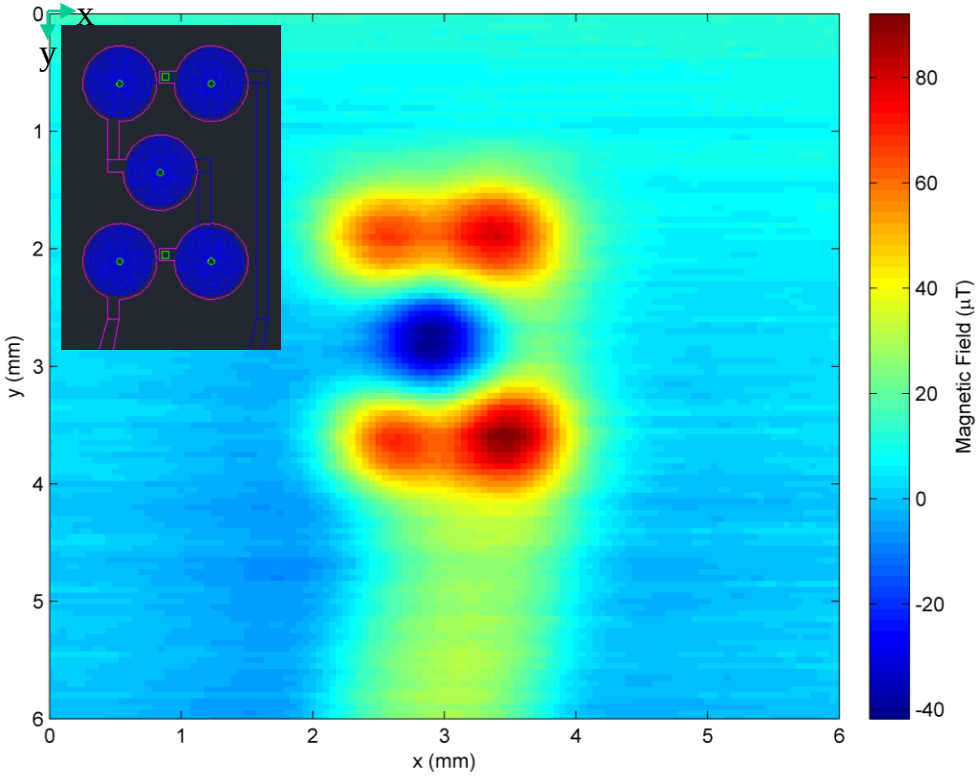
Magnetic Trapping – 100mA

INESC-MN

Coil Parameters:

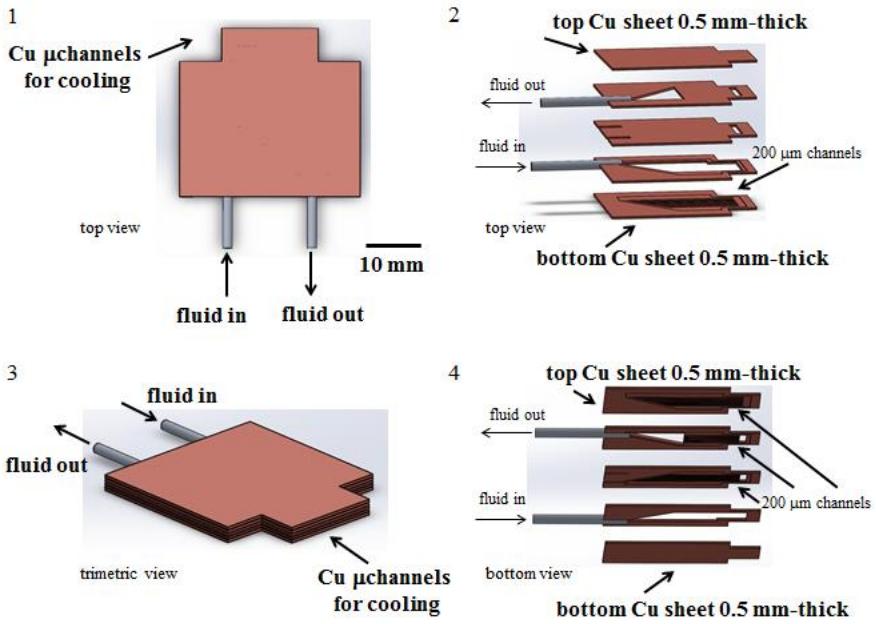
- I_{bias}^{DC} = 100 mA
- h = 280µm

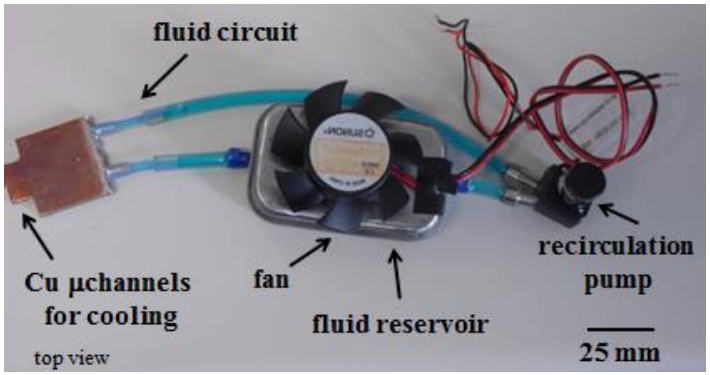


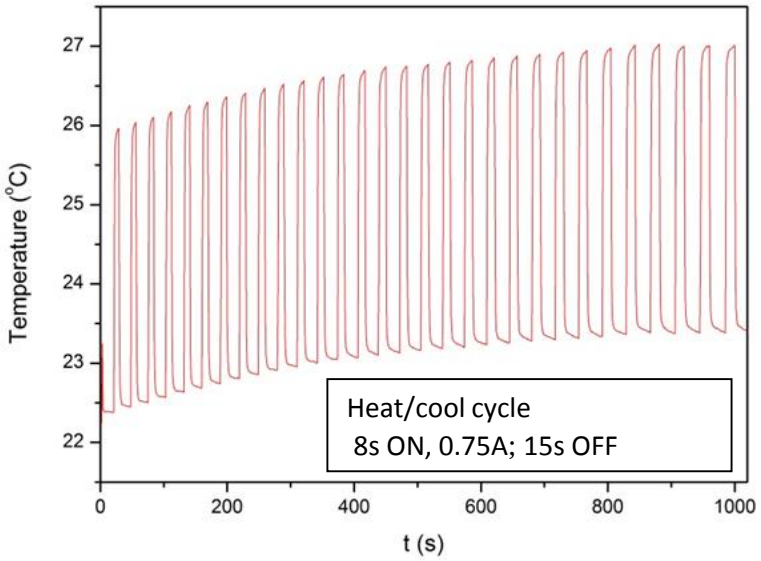


Cu cooling block - HOMOGENEOUS μCONCENTRATOR

5 COPPER SHEETS 0.5 MM - THICK
Coolant enters from the bottom and leaves from the top

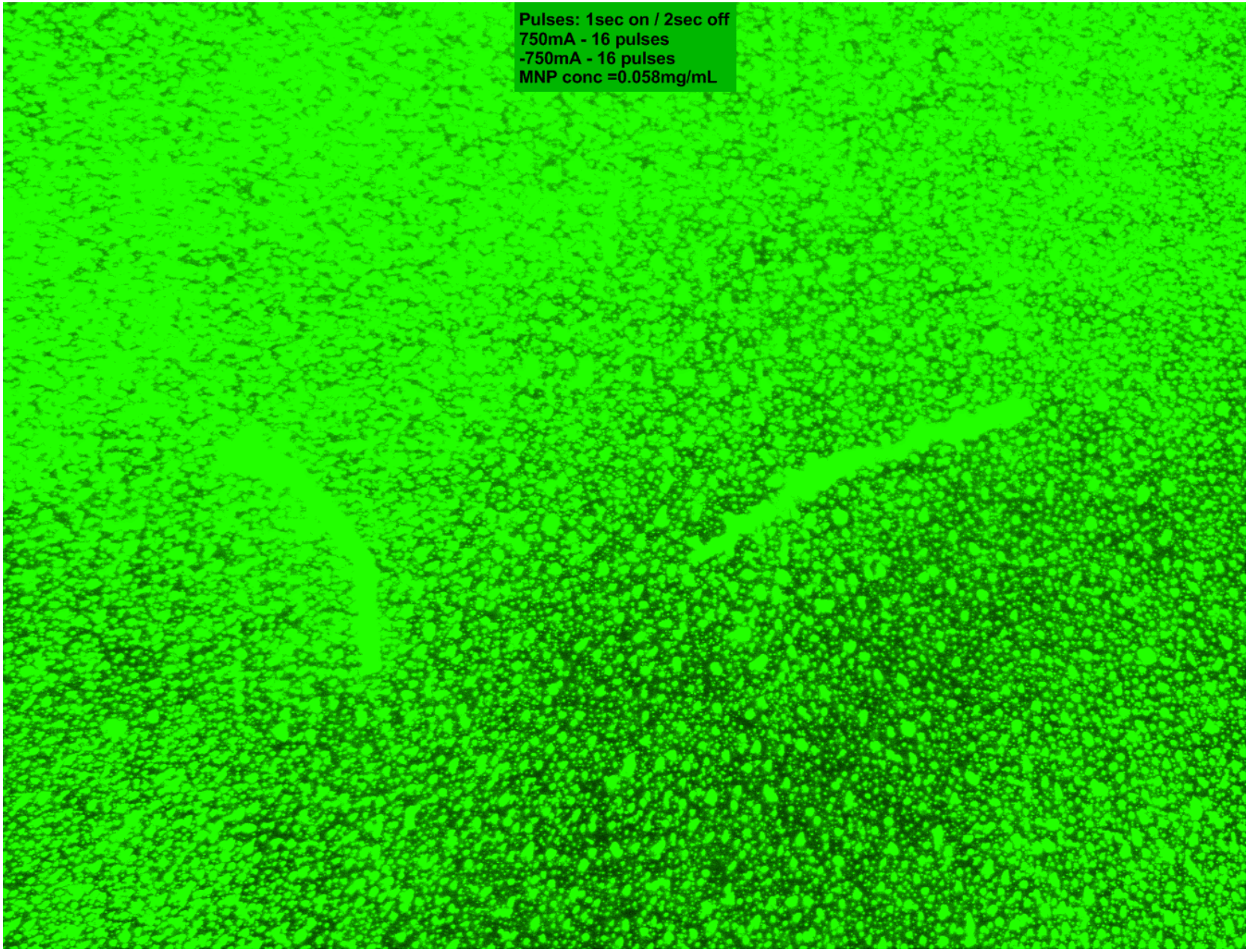




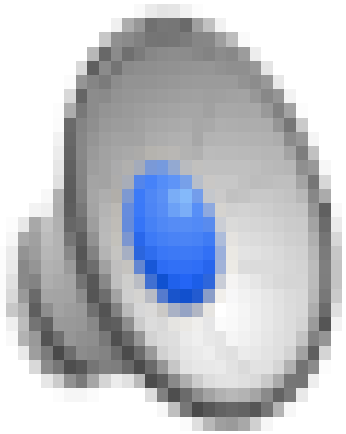


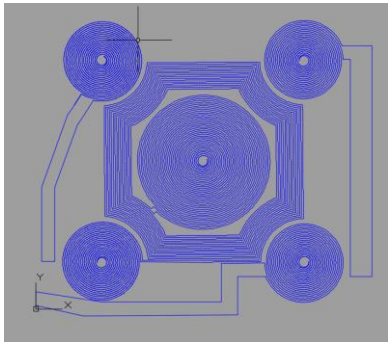
Cooling power 1W at 23C

TRAPPING EXPERIMENTS; 5 coil set up



Enlarging central coil

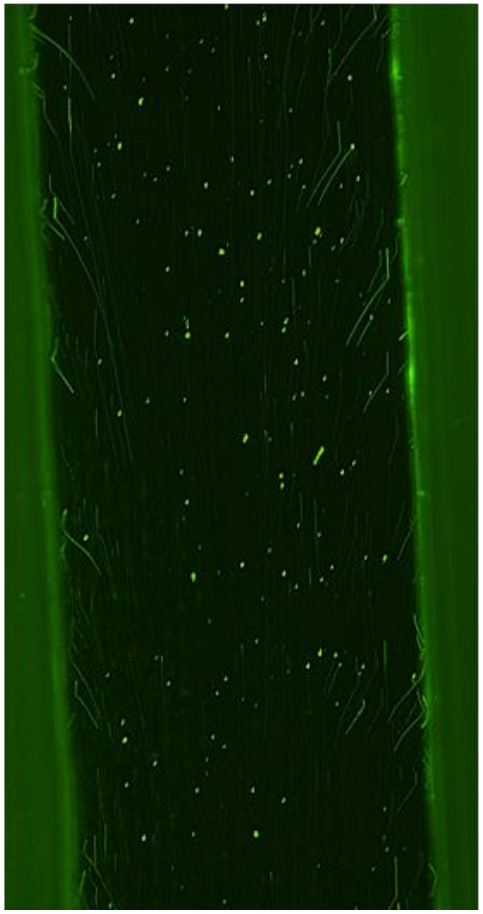




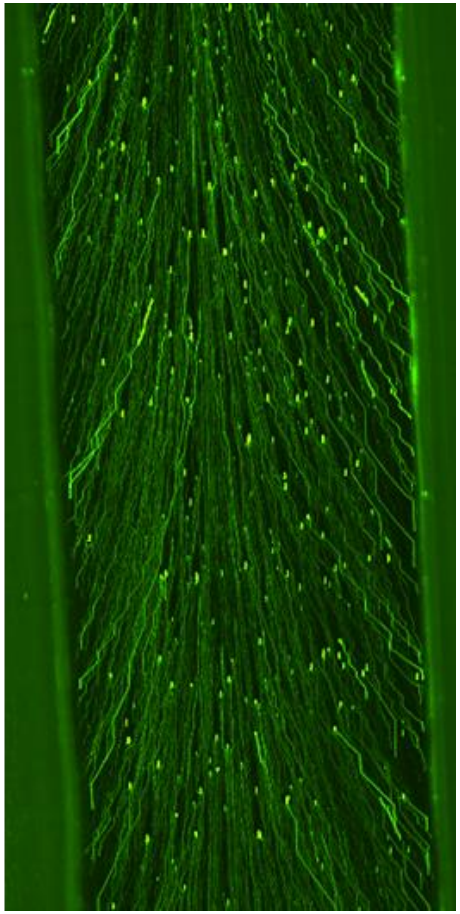
Green: fluorescent particles
Red: location of electromagnet tracks

4x speed up
On video:
9x repelling cycles
20x attracting cycles
Each:
2s on, 4s off at 0.5A)
Resistance ~ 6 Ohms
Channel section: 100um*2.5mm
Channel to chip: 100um
Channel to magnet: 9mm

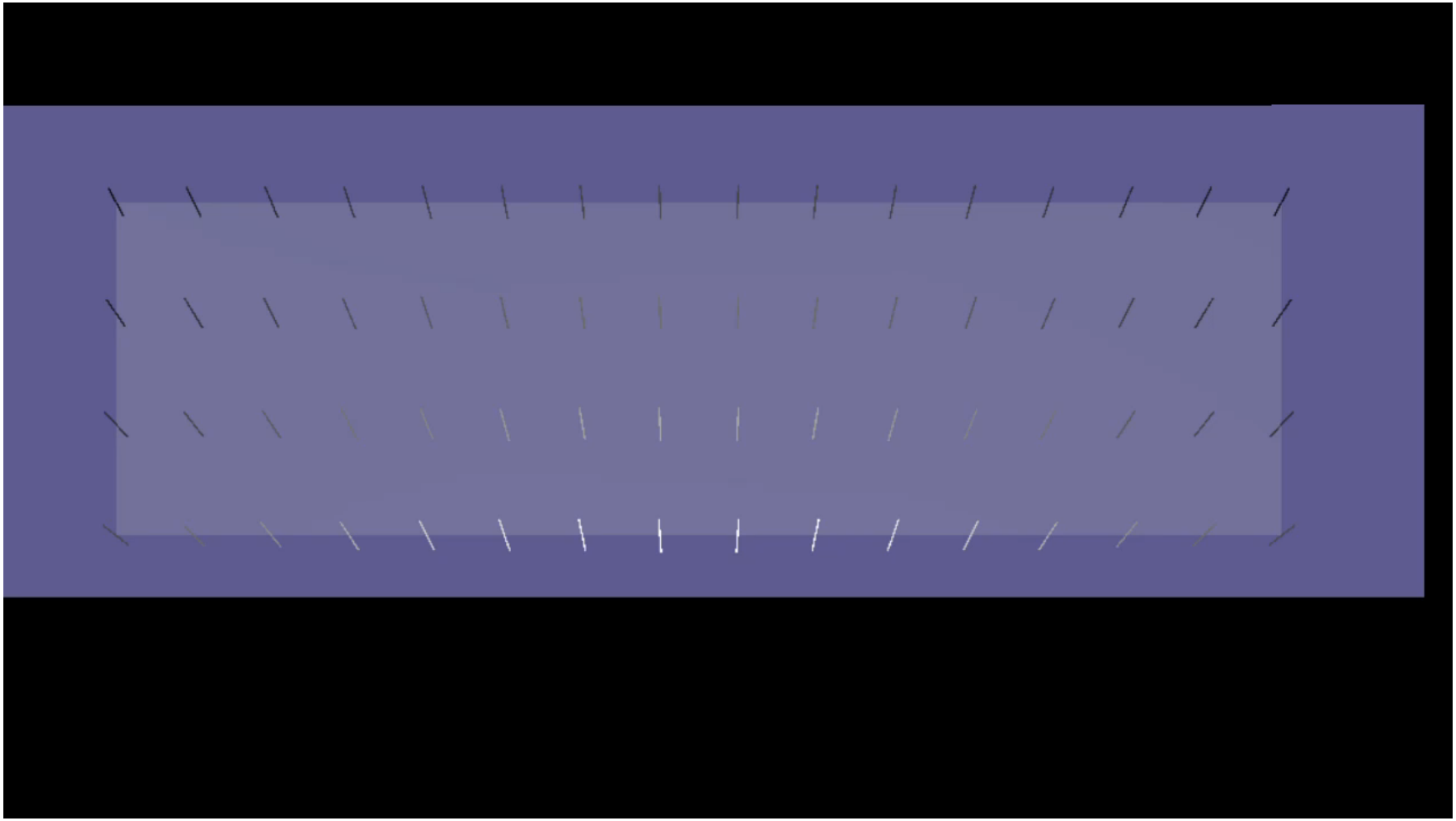
I= 0 A



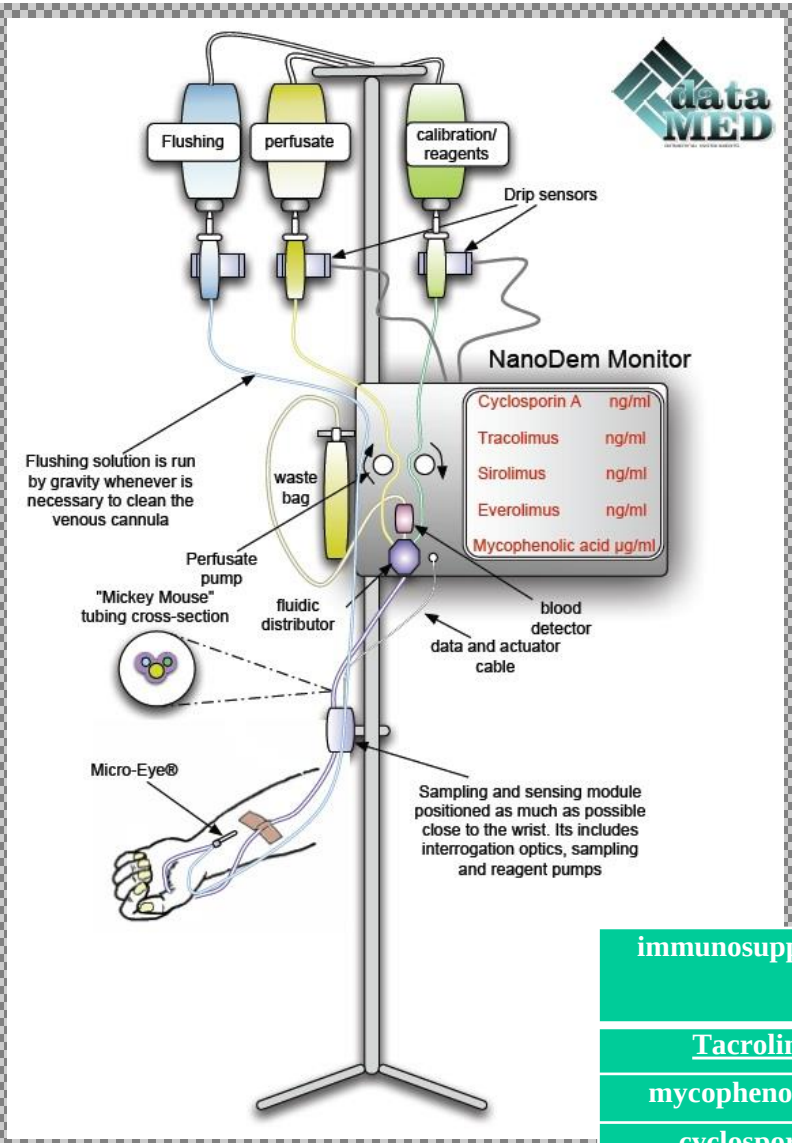
I=-0.5 A



I=+0.5 A



PRE CLINICAL TESTS LAST 6 MONTHS Of PROJECT



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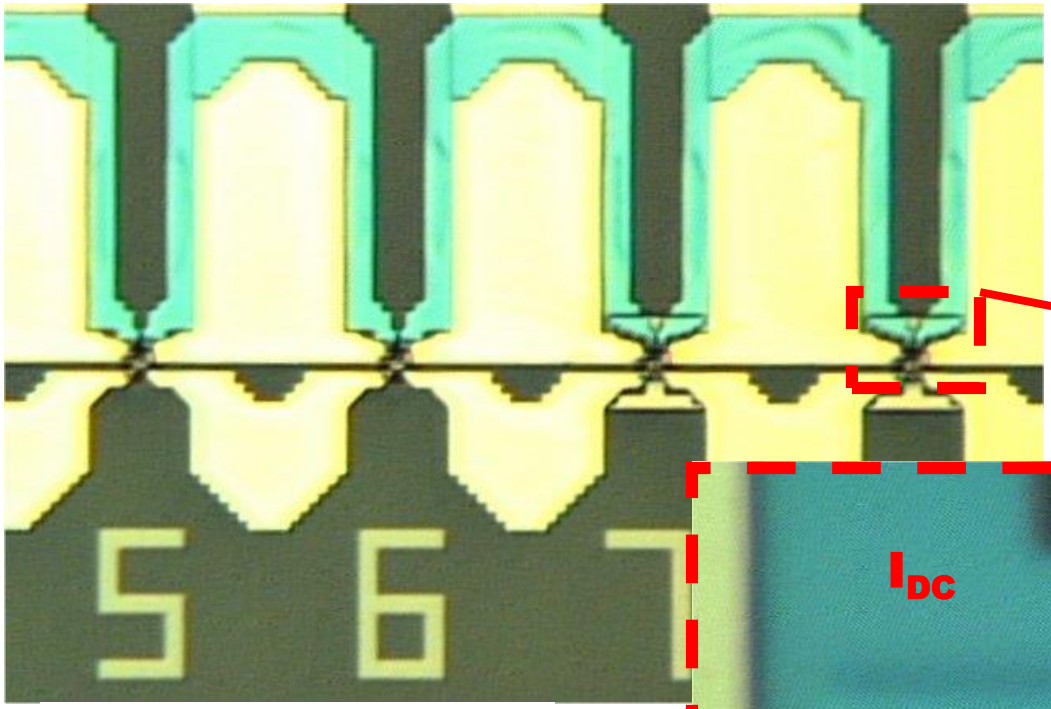
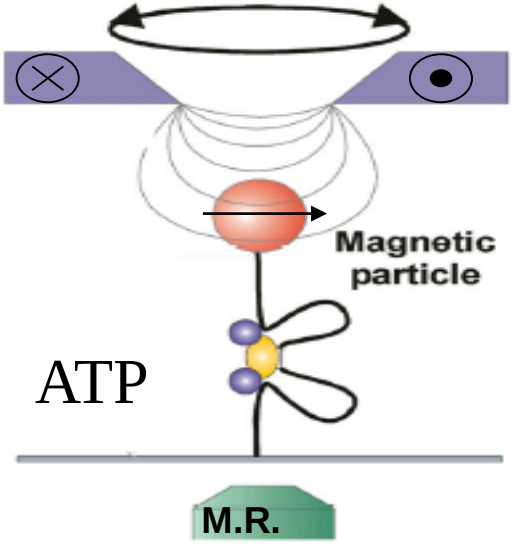
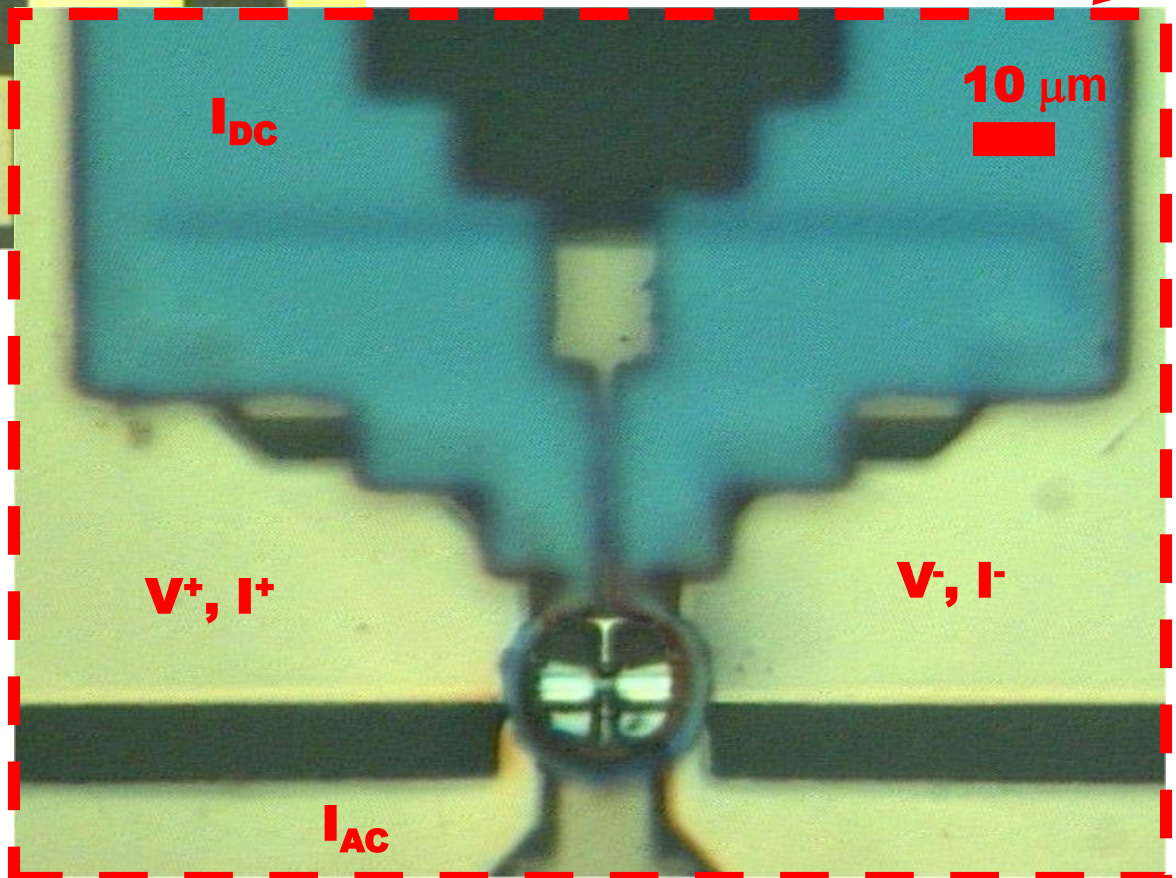
cyclosporin A	20 ng/ml	20 pg/ml
Sirolimus	1 ng / mL	1 pg / mL
Everolimus	0.5 ng / mL	0.5 pg / mL

Magnetic Tweezer, DNA manipulation, DNA translocation

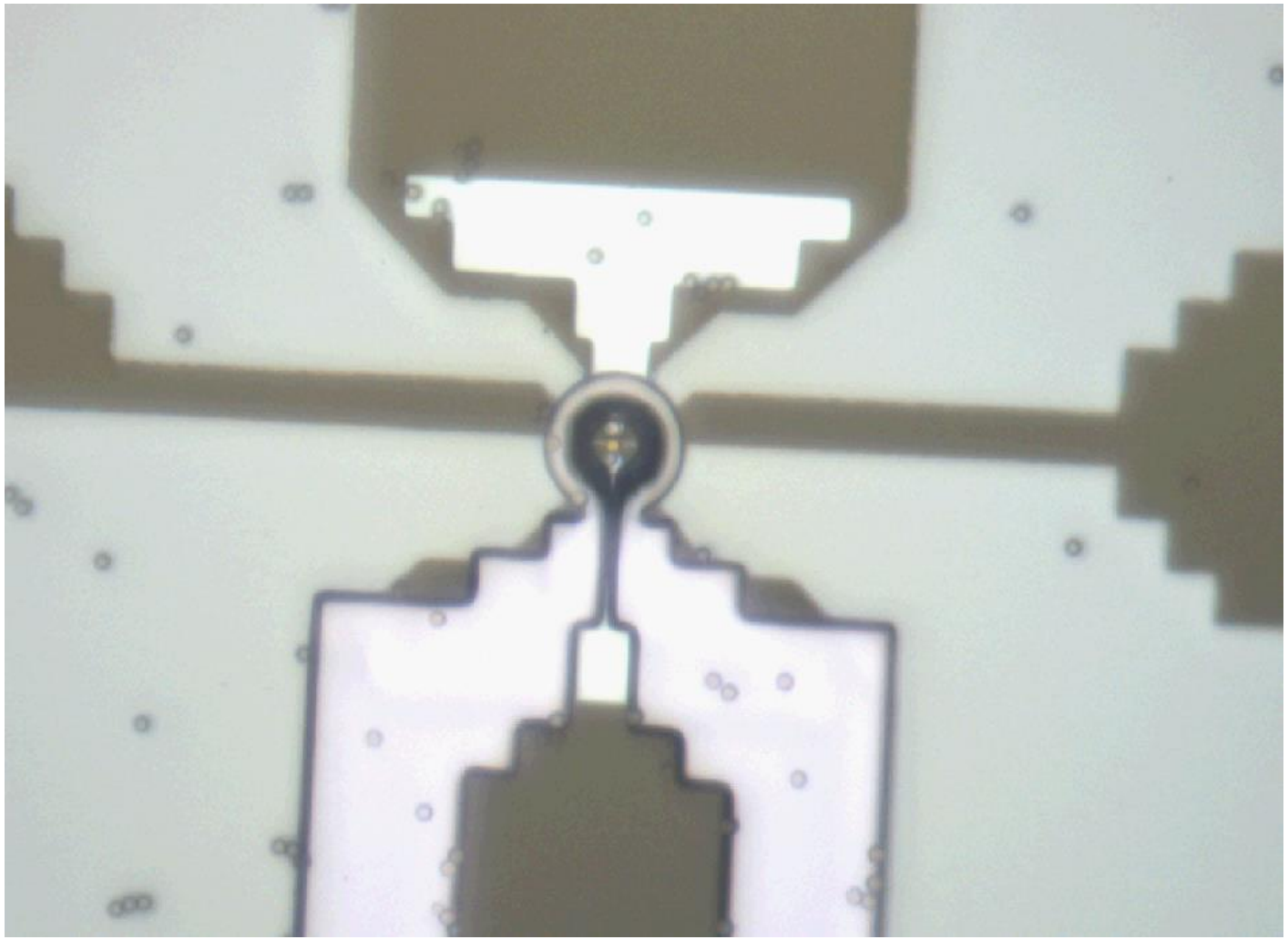
FP6 BioMolSwitch







Optical μScope – Vertical Switch



I_{MT}

0 mA

45 mA

Achieved:
60nm resolution

Inesc MN research group

INL

www.inesc-mn.pt

Obrigado!