

Sistemas microfluídicos descartáveis para aplicações no ponto de necessidade

Prof. Wendell K. T. Coltro

✉ E-mail: wendell@ufg.br

gme.quimica.ufg.br

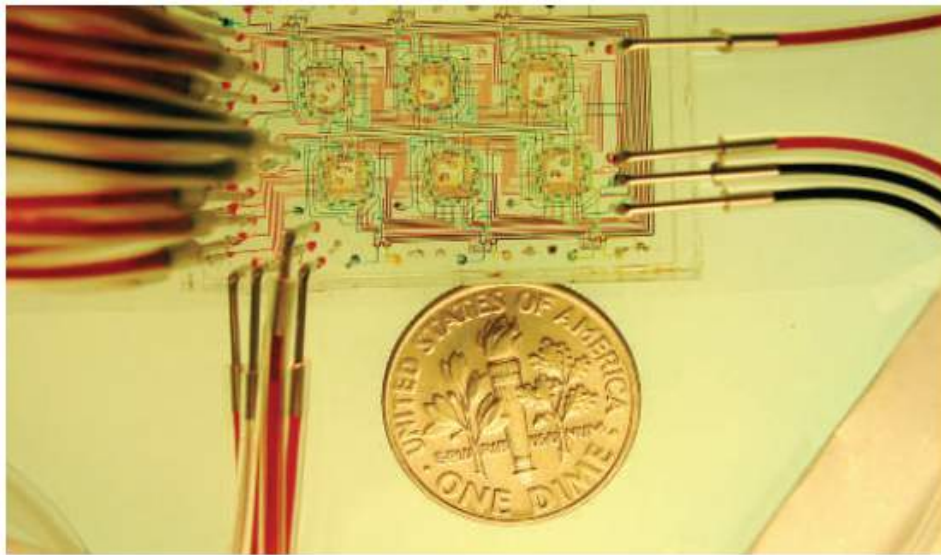
Outline

- ✓ **Microfluidics**
- ✓ **Toner- and Paper-based devices**
- ✓ **Bioanalytical applications**
- ✓ **Forensic Applications**
- ✓ **Wearable microfluidic sensors**

The origins and the future of microfluidics

George M. Whitesides¹

The manipulation of fluids in channels with dimensions of tens of micrometres — microfluidics — has emerged as a distinct new field. Microfluidics has the potential to influence subject areas from chemical synthesis and biological analysis to optics and information technology. But the field is still at an early stage of development. Even as the basic science and technological demonstrations develop, other problems must be addressed: choosing and focusing on initial applications, and developing strategies to complete the cycle of development, including commercialization. The solutions to these problems will require imagination and ingenuity.

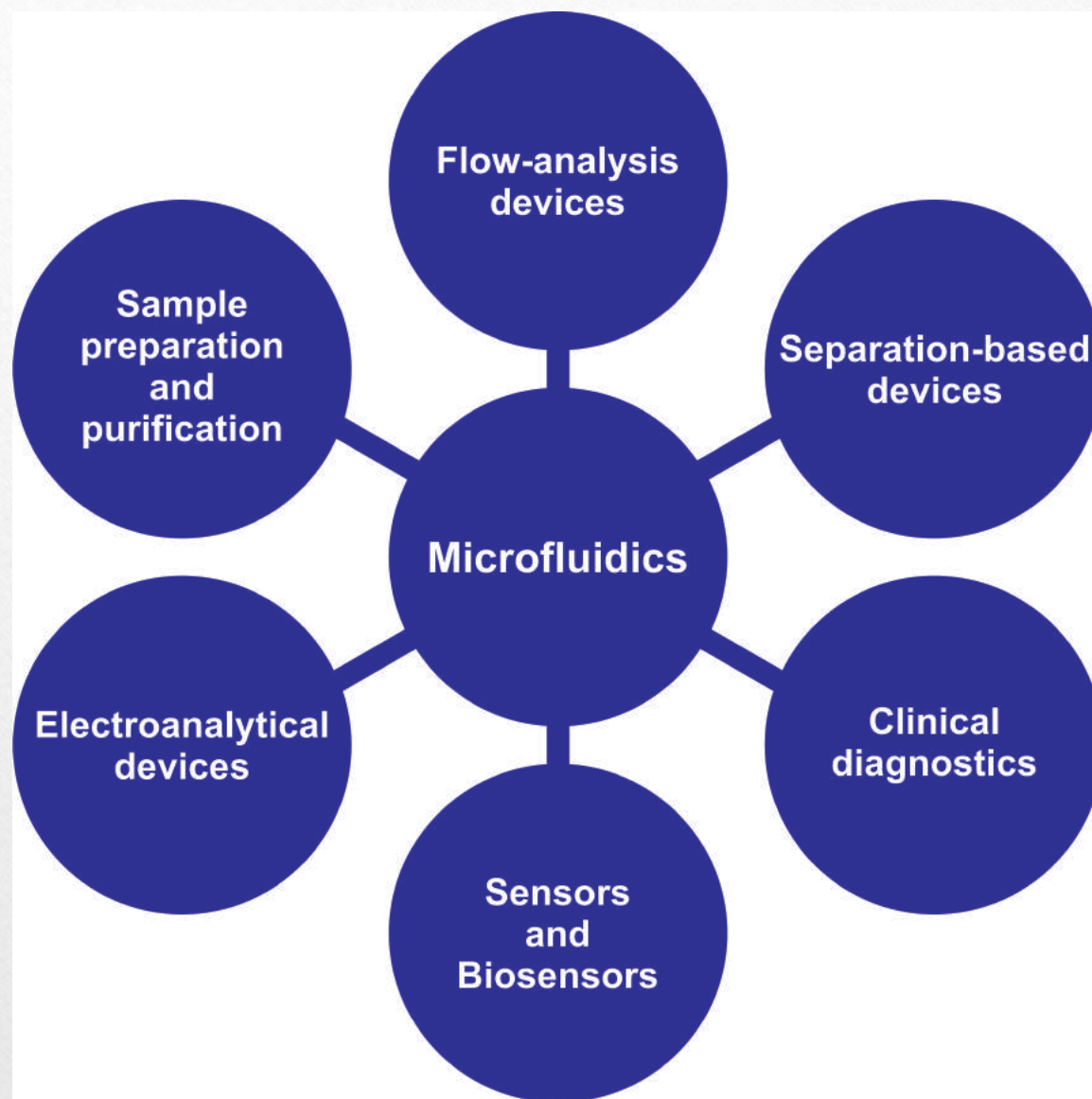


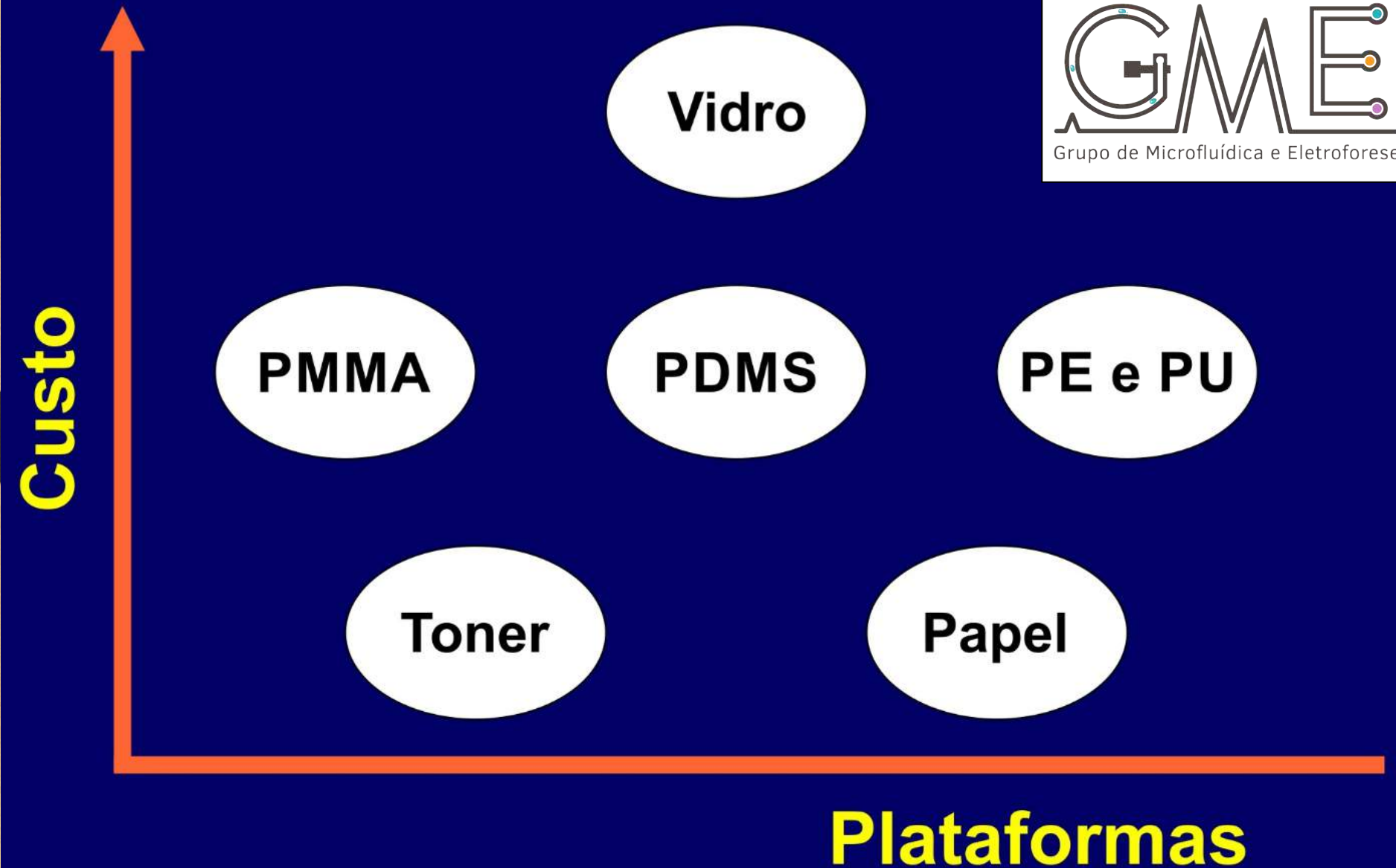
Microchips

Microdevices

Lab-on-a-Chip

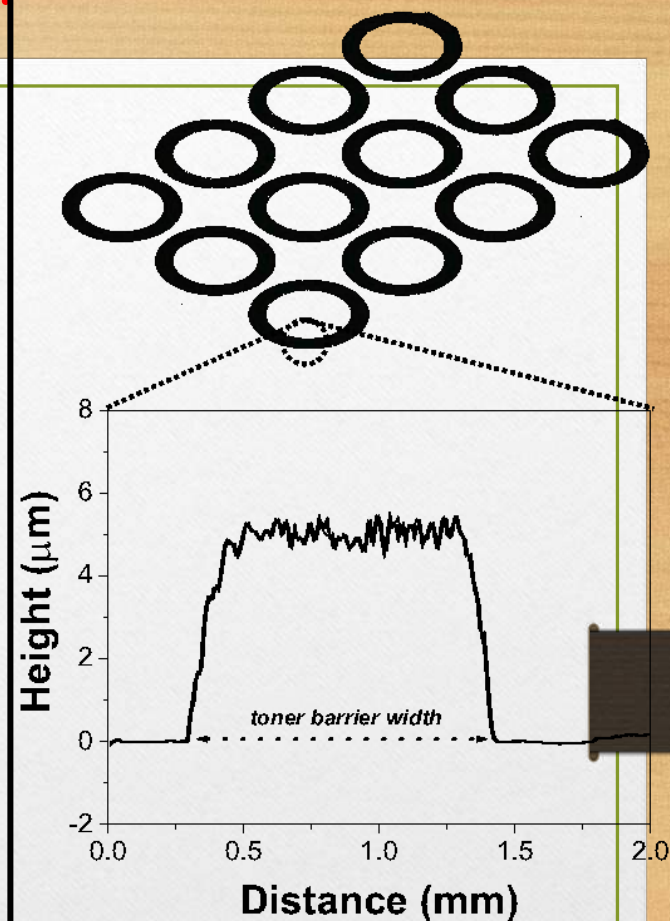
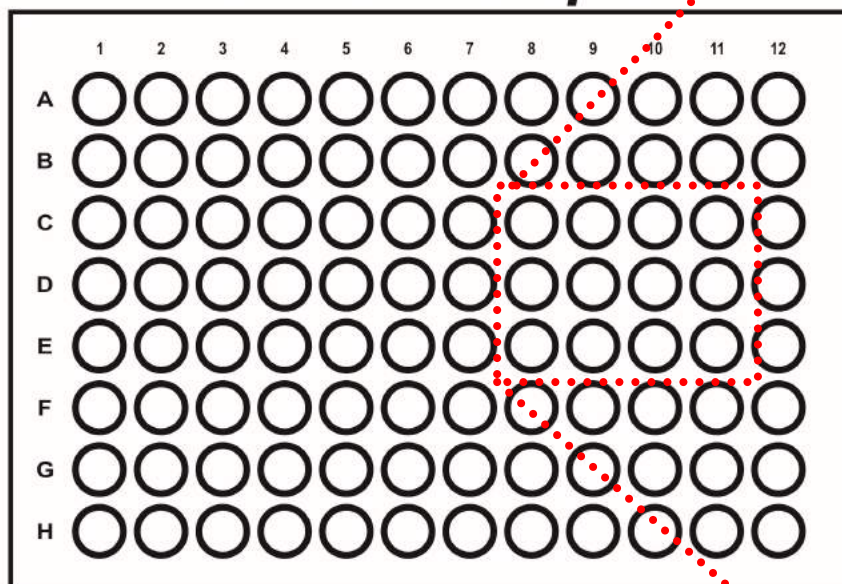
μ TAS





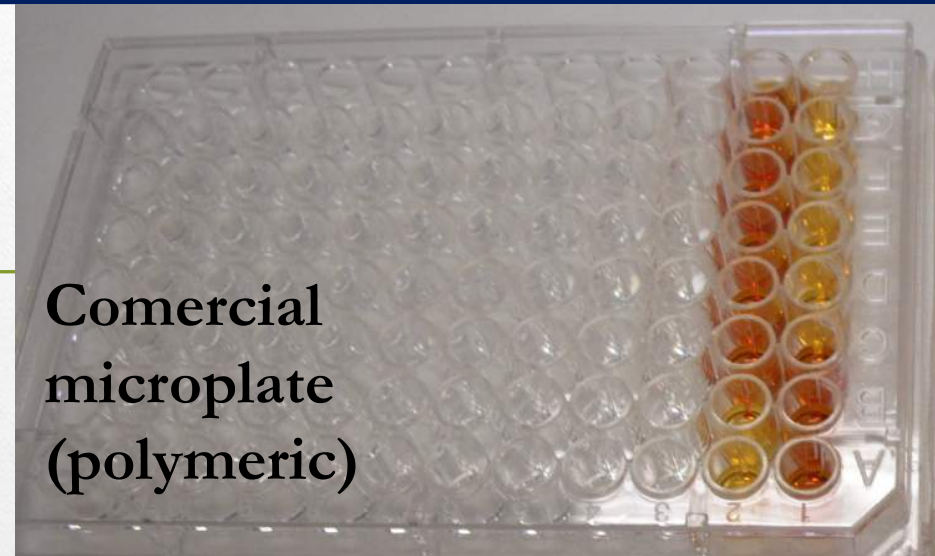
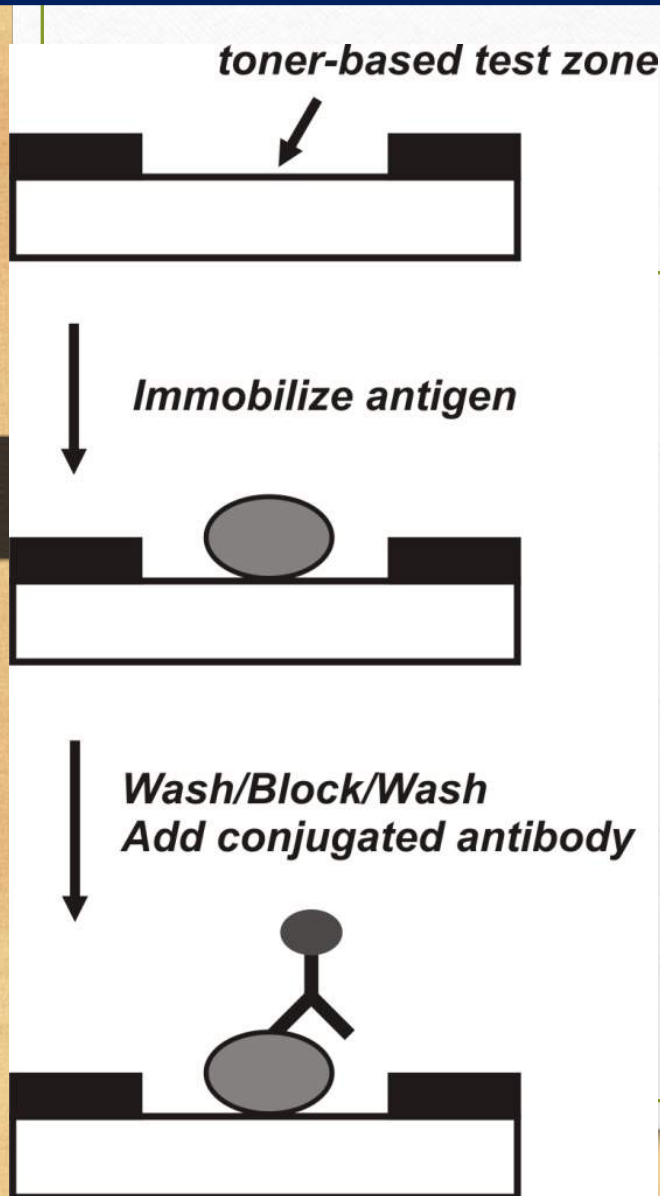
PRINTED MICROZONES

Positive microplate



Oliveira et al., *Analyst* 2013, 138, 1114-1121.

TONER-BASED MICROZONES FOR ELISA EXPERIMENTS



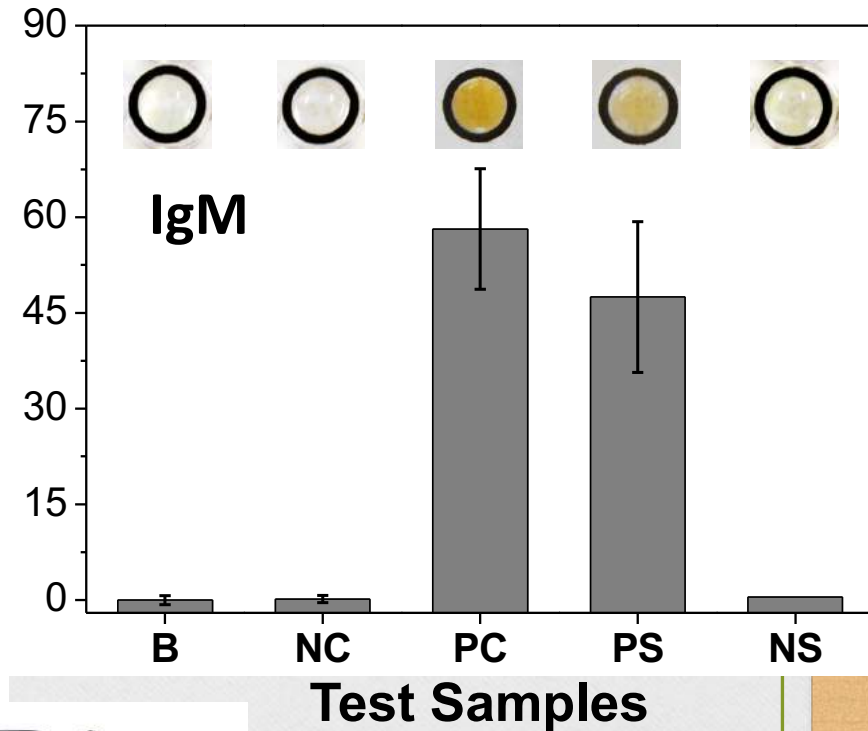
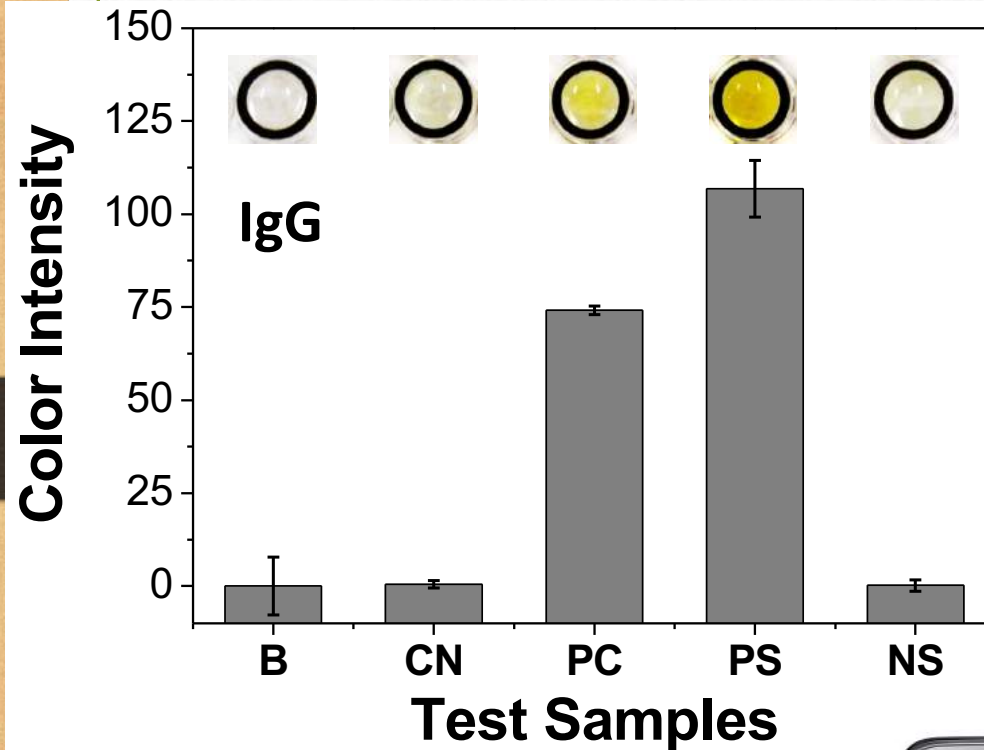
Comercial
microplate
(polymeric)



Toner microzone plate

DENGUE DIAGNOSTICS

IgG and IgM detection



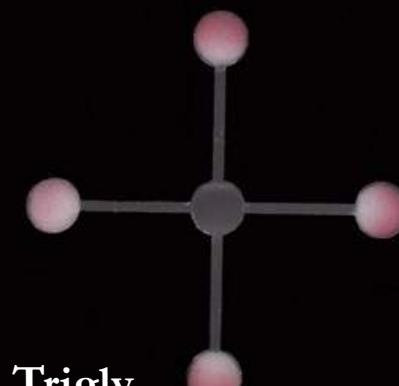
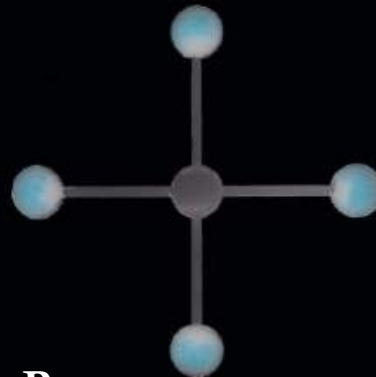
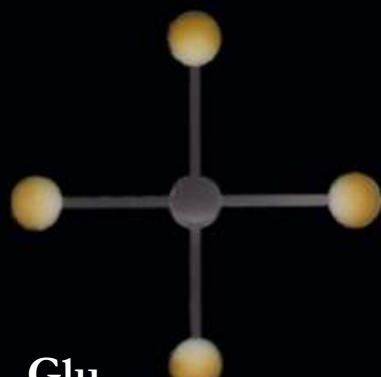
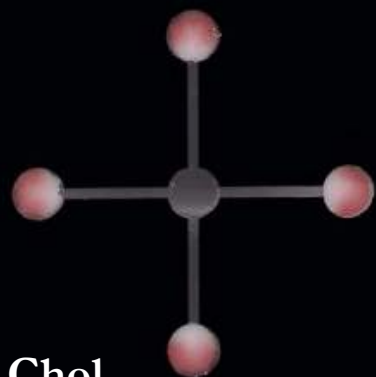
U\$ 100 — 500

Capillary-Driven Toner-Based Microfluidic Devices for Clinical Diagnostics with Colorimetric Detection

Fabrício Ribeiro de Souza,[†] Guilherme Liberato Alves,[†] and Wendell Karlos Tomazelli Coltro^{*,†,‡}

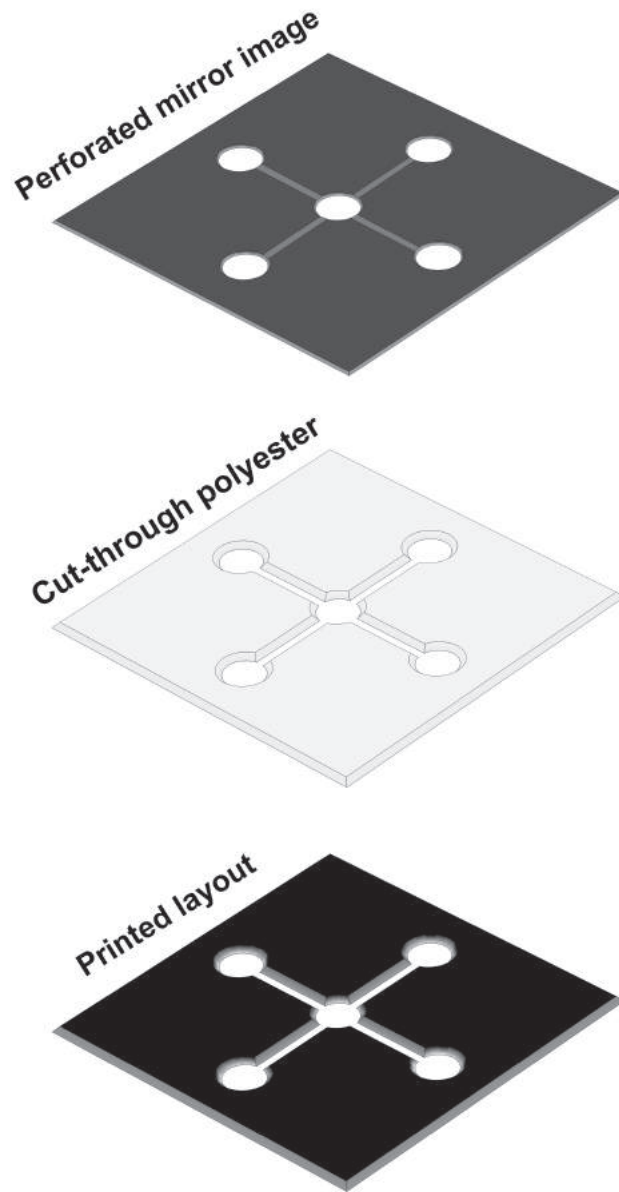
[†]Instituto de Química, Universidade Federal de Goiás, Campus Samambaia, P.O. Box 131, 74001-970, Goiânia, GO, Brazil

[‡]Instituto Nacional de Ciência e Tecnologia de Bioanalítica, 13083-970, Campinas, SP, Brazil

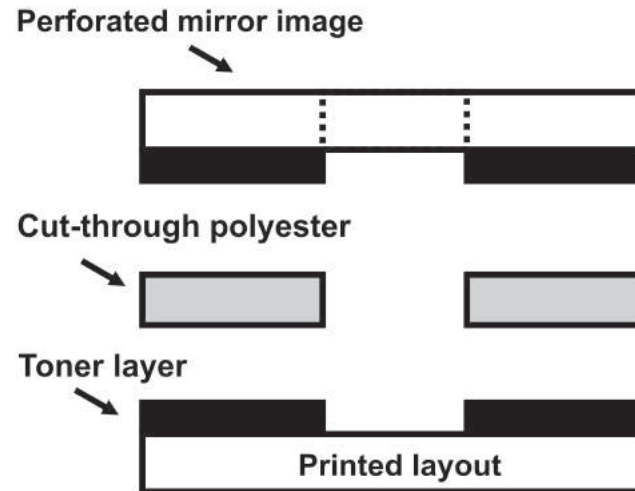


Capillary-driven Microfluidics/Toner devices

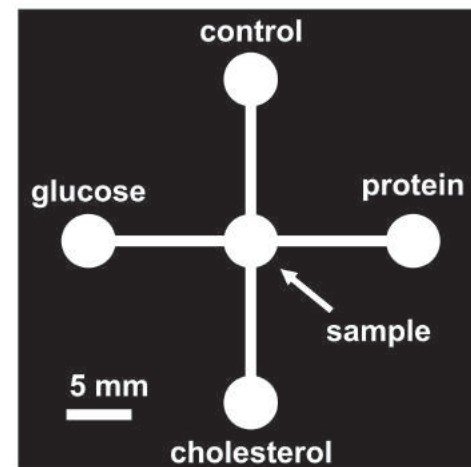
(A) 3D view



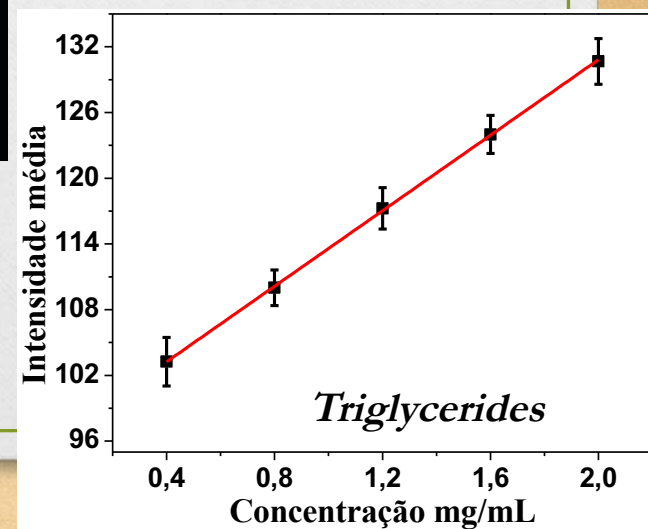
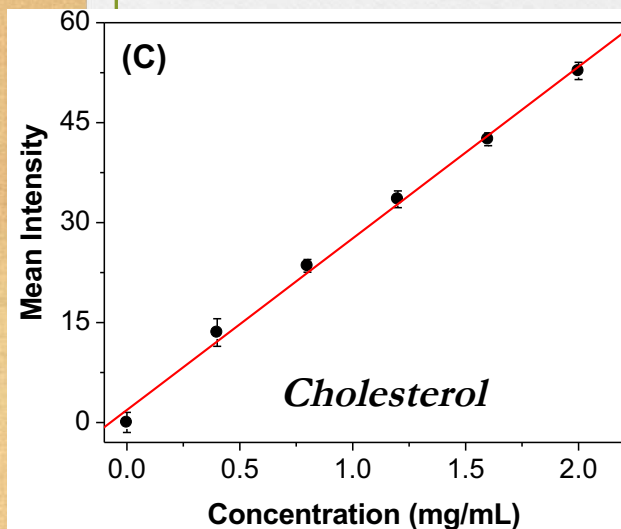
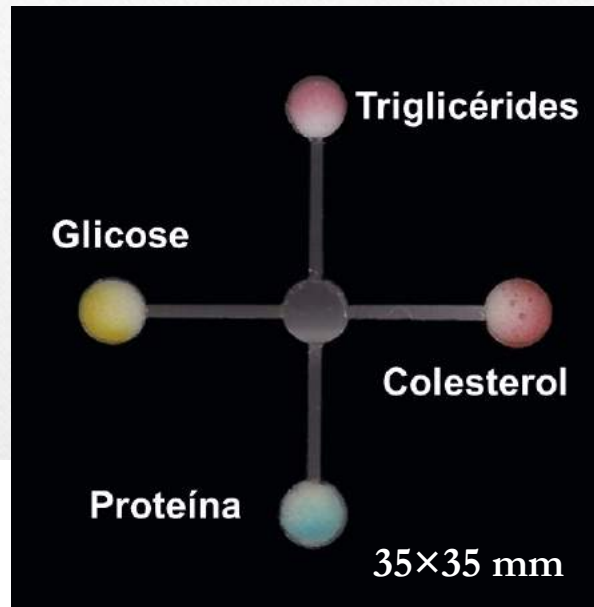
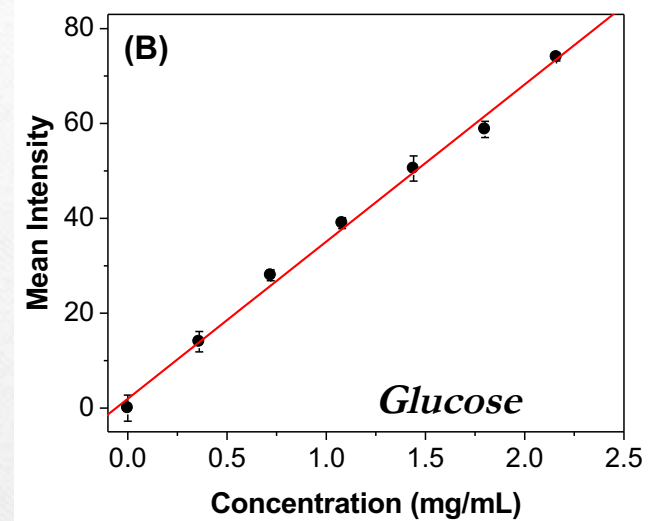
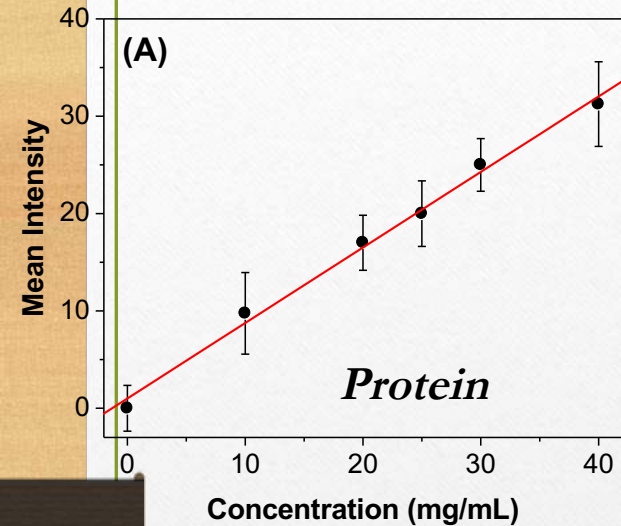
(B) Cross-section view



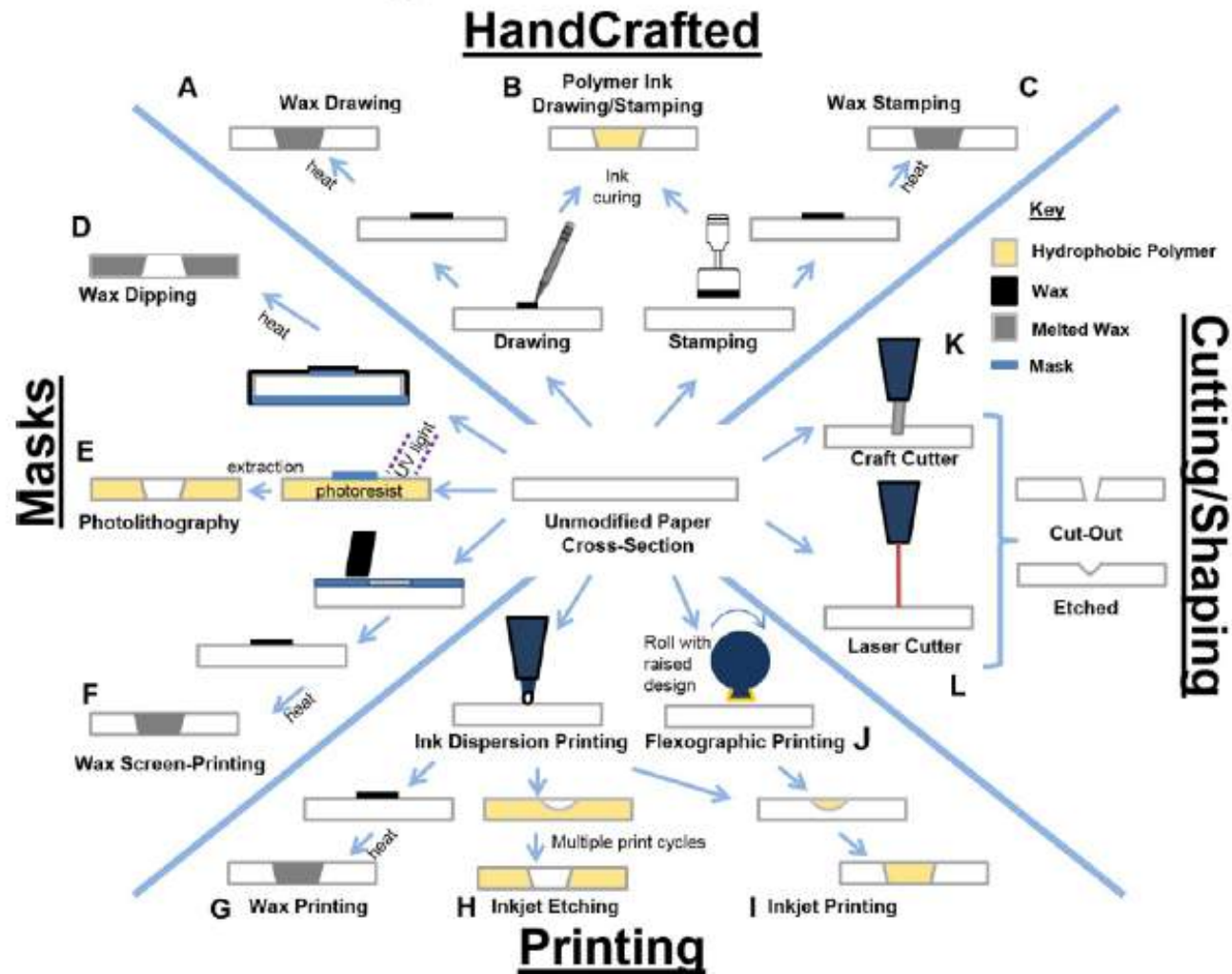
(C) Device layout



Clinical Assays/Concentration range



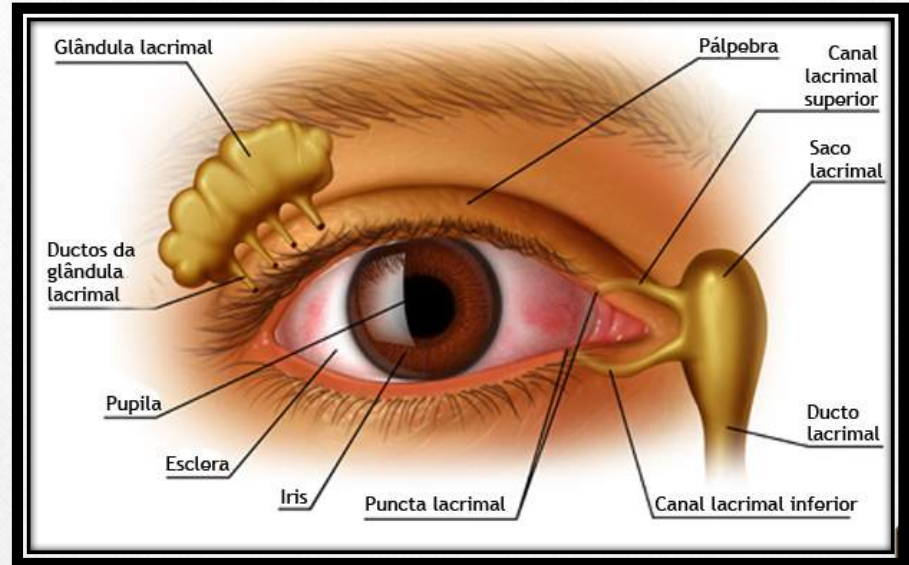
Paper microfluidics



Recent Developments in Paper-Based Microfluidic Devices

David M. Cate,[†] Jaclyn A. Adkins,[‡] Jaruwan Mettakoonpitak,[‡] and Charles S. Henry^{*,†,‡}

Tears – Glucose levels?



Composition:

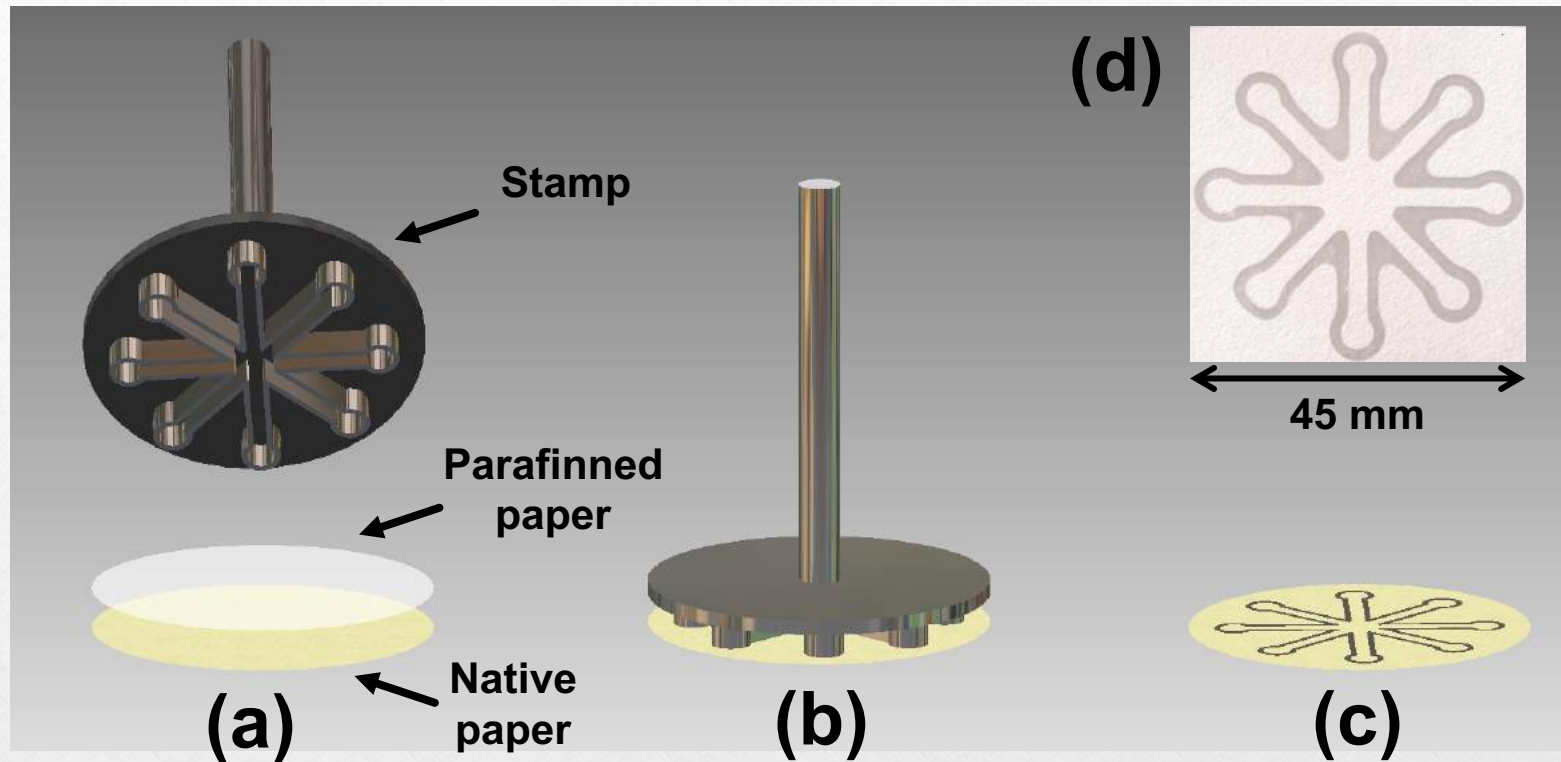
Water

Electrolytes (Na^+ , K^+ , Ca^{2+} , Mg^{2+} , Cl^- , HCO^-)

Proteins

Glucose, Lactate, Urea...

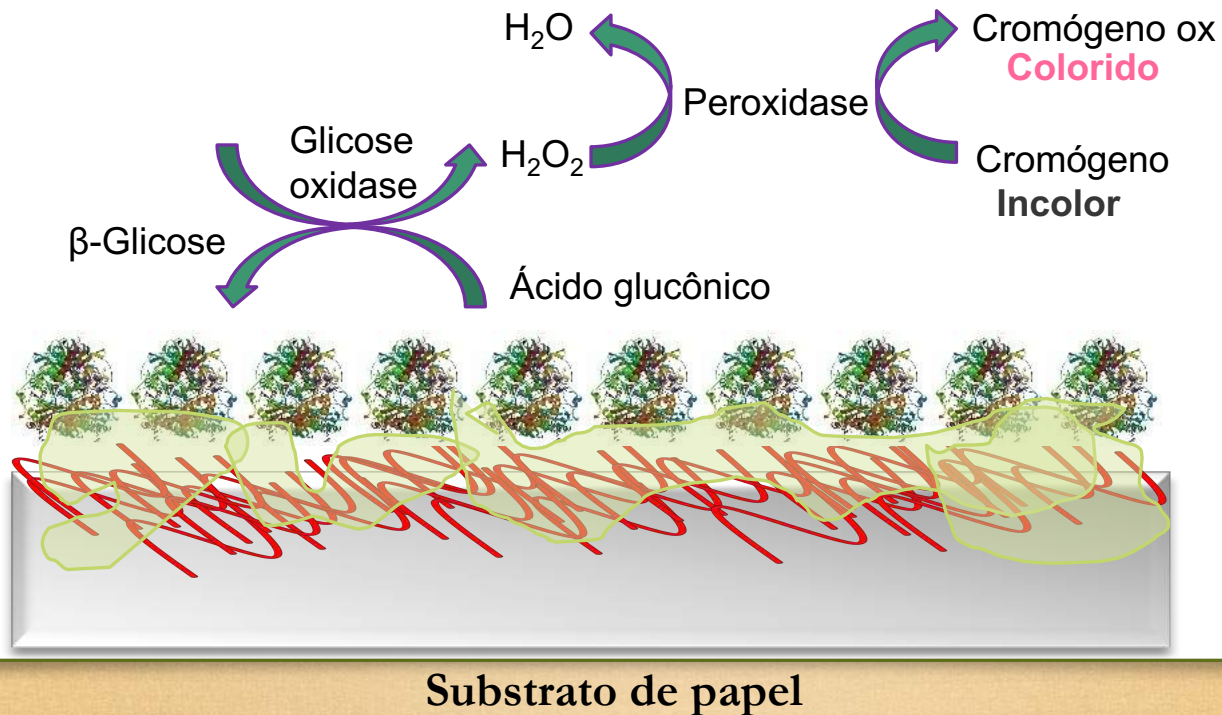
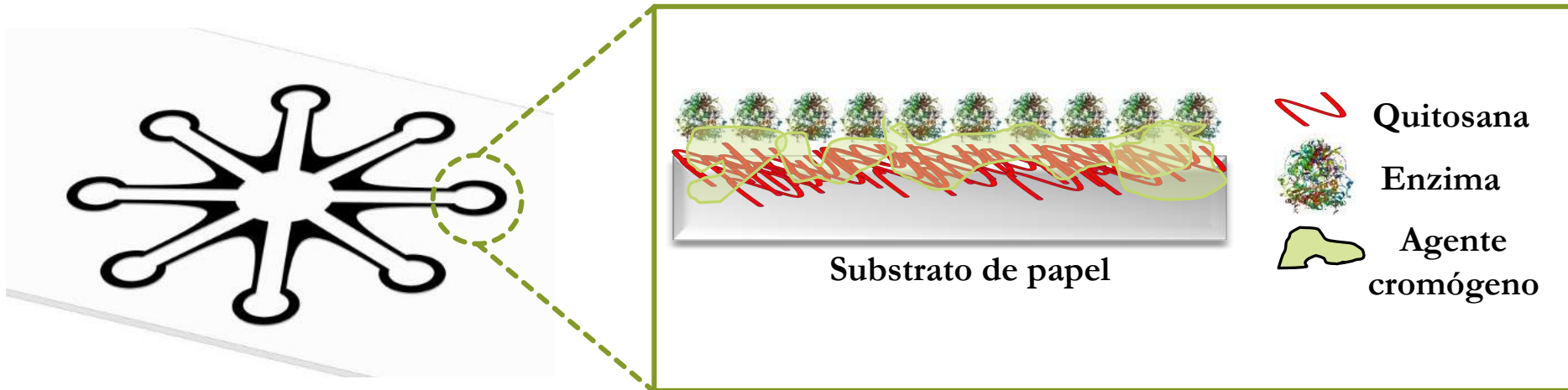
Paper microfluidic devices



Garcia et al., RSC Advances 2014, 4 (71), 37637-37644

1. Detectability levels?
2. Sample collection?

Chitosan on Paper



Real Samples

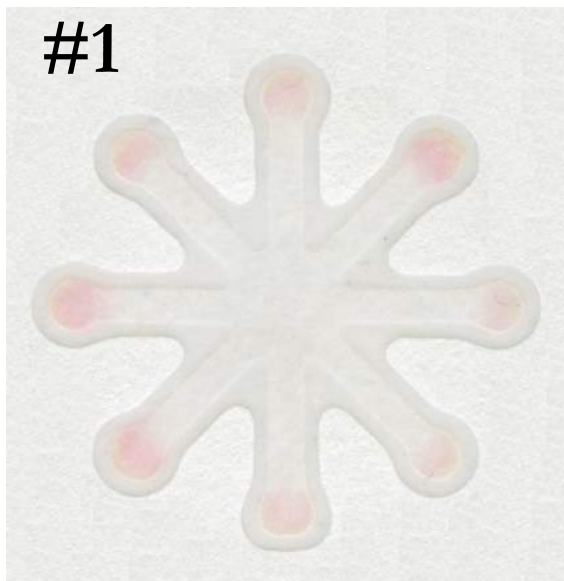


4-APP/DHBS

- ✓ non-invasive
- ✓ Sample prep
- ✓ Recovery = 95 – 102%
- ✓ Wearable sensors

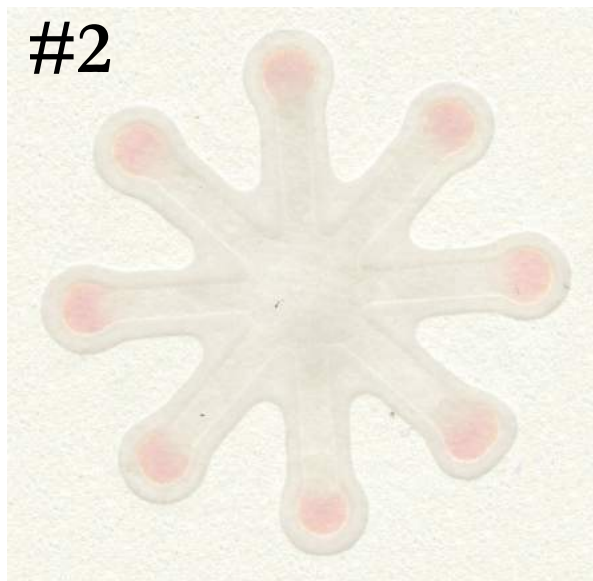
Gabriel, Garcia, Cardoso, Marques, Martins, Coltro. *Analyst* 2016, 141, 4749.

#1



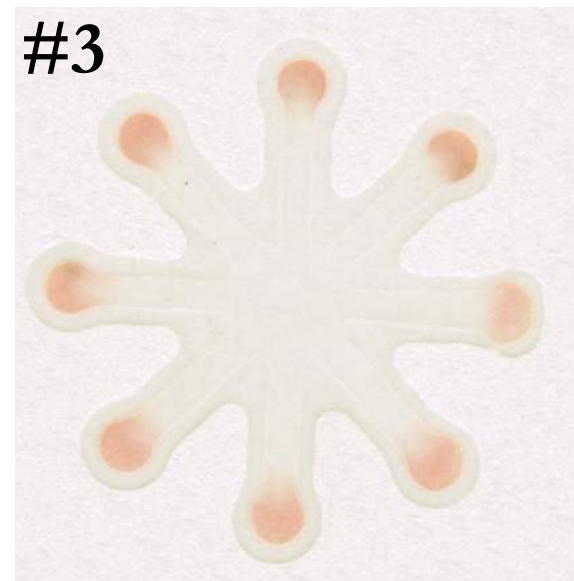
$0.20 \pm 0.01 \text{ mM}$

#2



$0.13 \pm 0.01 \text{ mM}$

#3

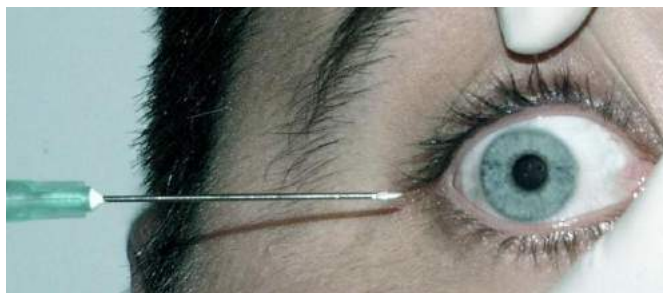
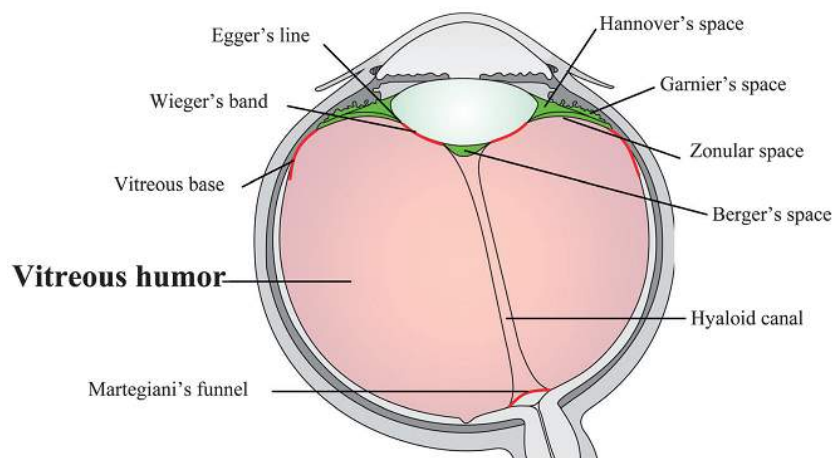


$0.34 \pm 0.01 \text{ mM}$

Metals and (metallo)proteins identification in vitreous humor focusing on post-mortem biochemistry



Júlio César Santos Júnior,^a Pedro Carlos Mollo Filho,^b
Ruggero Bernardo Felice Guidugli,^b Marcos Nogueira Eberlin,^c
Gustavo de Souza Pessoa,^d Elidiane Gomes da Silva,^d Marco Aurélio Zezzi Arruda^d
and Nelci Fenalti Höehr^{*a}

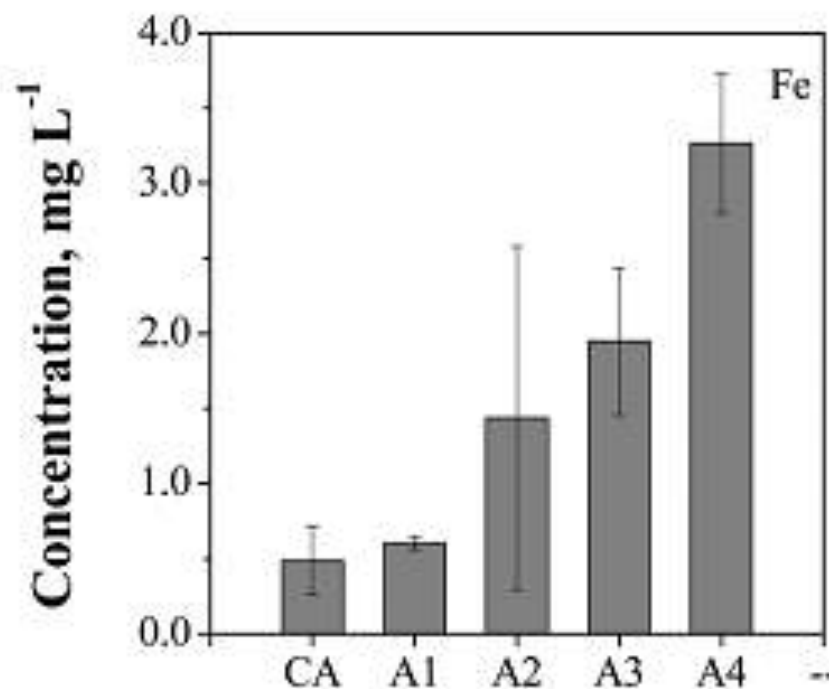
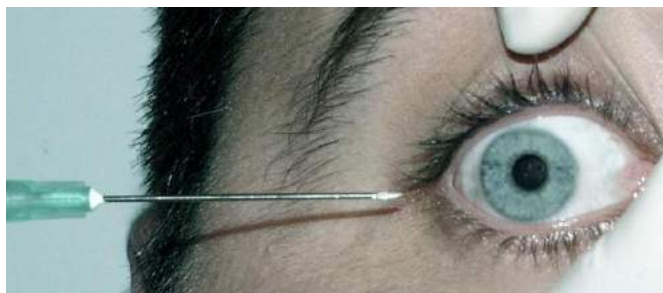
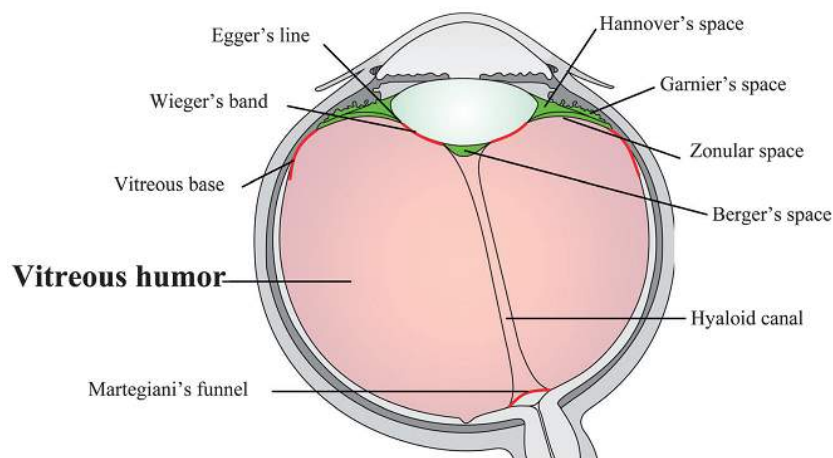


Santos Junior, *et al.* Metallomics, **2014**, 6, 1801.

Metals and (metallo)proteins identification in vitreous humor focusing on post-mortem biochemistry



Júlio César Santos Júnior,^a Pedro Carlos Mollo Filho,^b
Ruggero Bernardo Felice Guidugli,^b Marcos Nogueira Eberlin,^c
Gustavo de Souza Pessoa,^d Elidiane Gomes da Silva,^d Marco Aurélio Zezzi Arruda^d
and Nelci Fenalti Höehr^{*a}



Santos Junior, *et al.* Metallomics, **2014**, 6, 1801.

Santos Junior, *et al.* Metallomics, **2014**, 6, 1801.



ELSEVIER

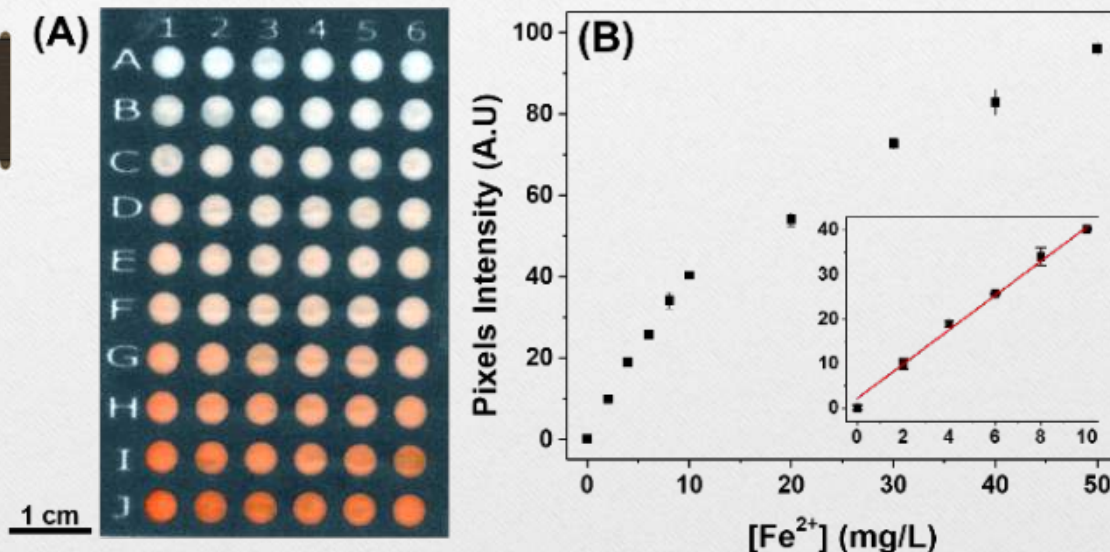
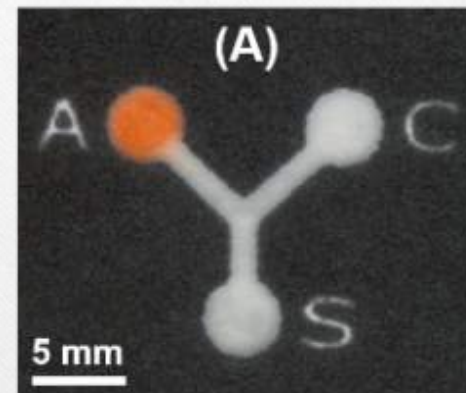
Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

Analytica Chimica Acta

journal homepage: www.elsevier.com/locate/aca

Paper-based microfluidic devices on the crime scene: A simple tool for rapid estimation of post-mortem interval using vitreous humour

Paulo T. Garcia^a, Ellen F.M. Gabriel^a, Gustavo S. Pessôa^b, Júlio C. Santos Júnior^c, Pedro C. Mollo Filho^d, Ruggero B.F. Guidugli^d, Nelci F. Höehr^c, Marco A.Z. Arruda^{b, e}, Wendell K.T. Coltro^{a, e, *}



Garcia et al., *Analytica Chimica Acta*, 2017, 974, 69-74

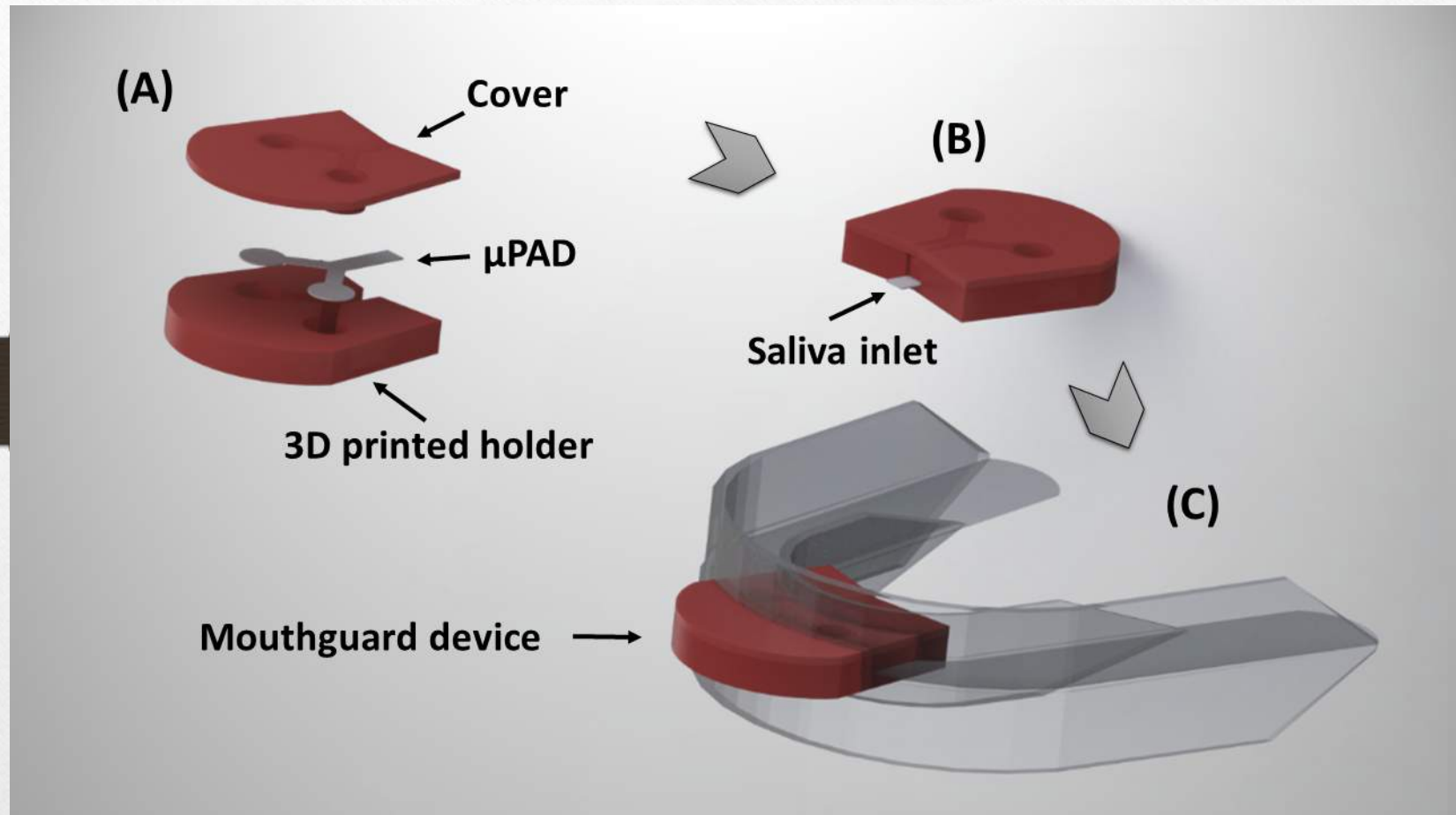
Post-mortem interval

VH Samples	ICP-MS (mg/L)	Paper Device (mg/L)	PMI
#1	0.55 ± 0.02	0.5 ± 0.1	1 Day
#2	0.66 ± 0.09	0.7 ± 0.1	1 Day
#3	1.07 ± 0.05	1.2 ± 0.1	3 Days
#4	14.72 ± 0.12	15.1 ± 0.3	7 Days

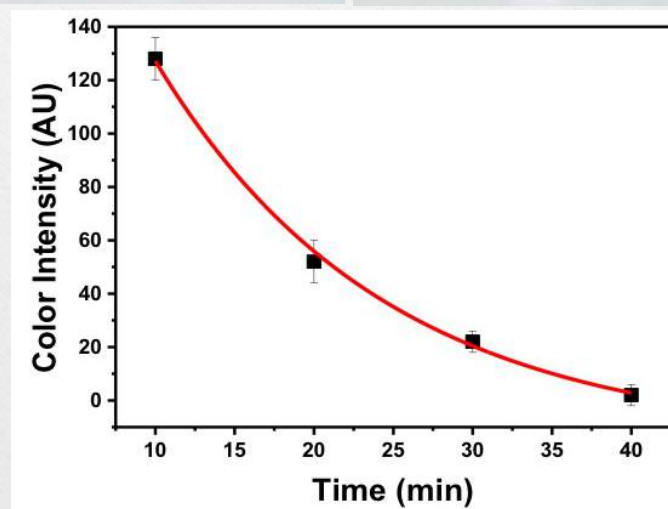
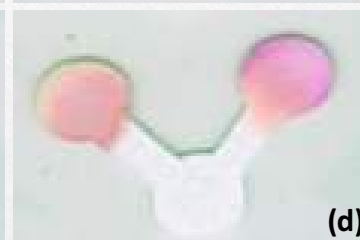
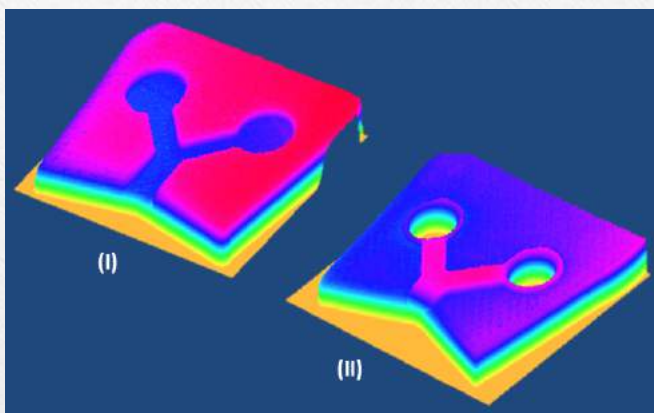
Main limitation: PMI \geq 1 day

Garcia et al., *Analytica Chimica Acta*, 2017, 974, 69-74

Wearable Sensors



de Castro et al., *Anal. Bioanal. Chem.*, 2019, 411, 4919–4928.



Summary – disposable POC devices

- Microfab approaches

 - Simple (draw/print/laminate/stamp/spray)

 - Low instrumental requirements

 - Fast (< 10 min)

 - Inexpensive ($< \text{U\$ } 0.50$)

- Colorimetric sensors:

 - High sensitivity (nano/bio-materials)

 - Noninvasive diagnostics

 - Crime scene

- POC Devices

 - Simplicity/disposability

 - Monitoring of clinically relevant analytes

Acknowledgements



Profa. Dra. Marília O. Fonseca de Goulart
Universidade Federal de Alagoas
Academia Brasileira de Ciências
Membro Titular

Prof. Dr. Emanuel Carrilho
USP – São Carlos
Mestrado - Doutorado
2002 – 2008



Acknowledgements



CAPES
CNPq

