



# EPIGRAPH





**RISE**

**li.u** LINKÖPING  
UNIVERSITY  
**Coordinator**

**AixMarseille**  
université

 **FORTH**  
INSTITUTE OF ELECTRONIC STRUCTURE AND LASER

# EPIGRAPH CONSORTIUM

| Partner Number          | Country | Institution/Department  | Name of the Principal Investigator (PI) | Name of the co-Investigators | Other participants         |
|-------------------------|---------|---|---|------------------------------|----------------------------|
| 1<br><i>Coordinator</i> | SWEDEN  | Linköping University<br>Department of Science and Technology  | Daniel Simon                            |                              | PhD Candidate              |
| 2                       | FRANCE  | Aix-Marseille Université<br>UMR INSERM 1106 / INS<br>Institut de Neurosciences<br>des Systèmes                          | Christophe Bernard                      |                              | Post-Doc                   |
| 3                       | GREECE  | Foundation for Research<br>and Technology Hellas<br>(FORTH) / Institute of<br>Electronic Structure and<br>Lasers (IESL) | Emmanuel Stratakis                      |                              | PhD Candidate,<br>Post-Doc |
| 4                       | SWEDEN  | RISE SICS AB  | Trine Vikinge                           | Emma Gundersson              |                            |

# LABORATORY OF ORGANIC ELECTRONICS

Campus Norrköping

>60 members

10 divisions

Täppan Cleanroom

Printed Electronics Arena

RISE Acreo





# The Laboratory of Organic Electronics



**Magnus Berggren**  
Lab director



**Xavier Crispin**  
Organic energy materials

**Igor Zozoulenko**  
Theory and modeling



**Isak Engquist**  
Paper electronics

**Simone Fabiano**  
Nanoelectronics



**Daniel Simon**  
Bioelectronics

**Eric Głowacki**  
Organic nanocrystals



**Magnus Jonsson**  
Photonics & nano-optics

**Eleni Stavrinidou**  
Electronic plants

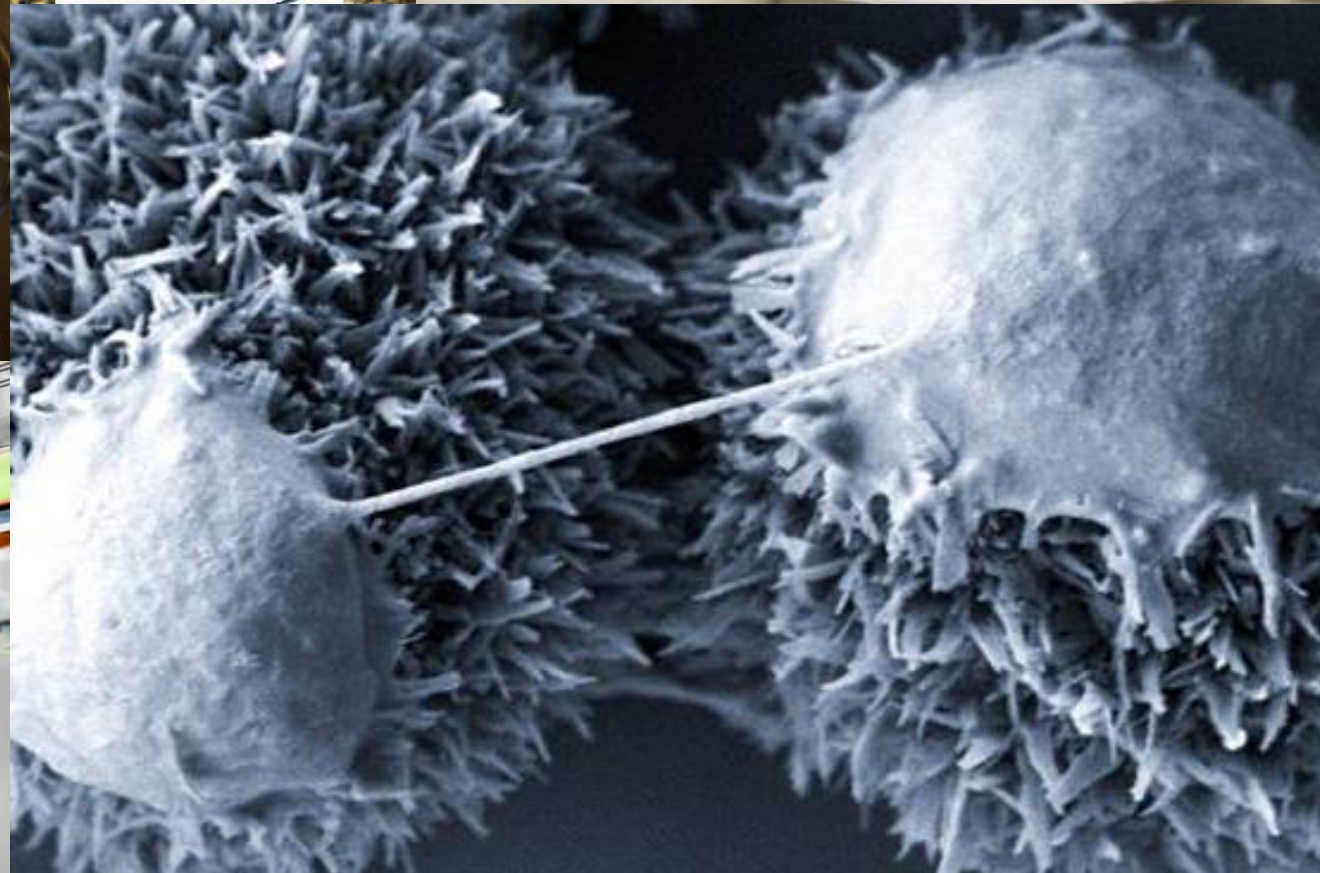
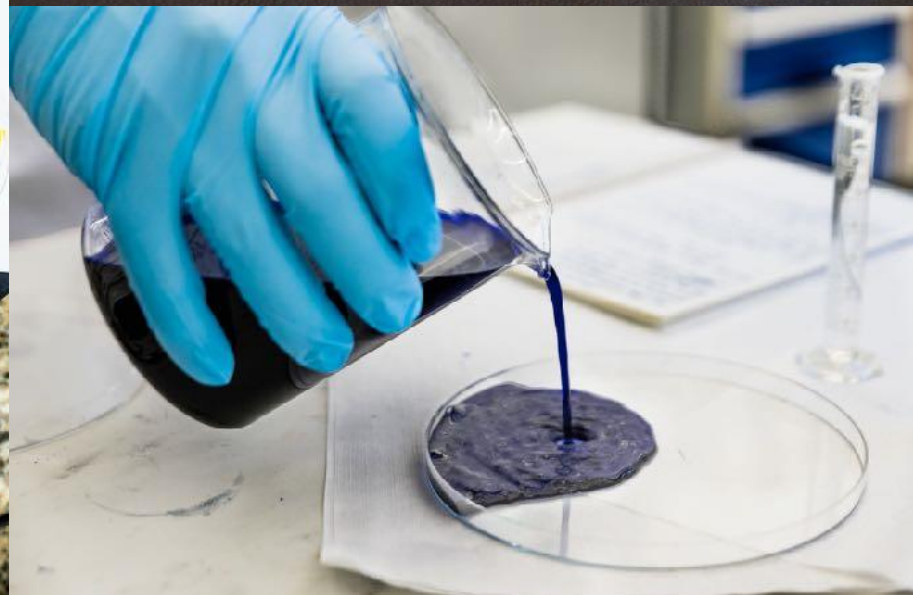
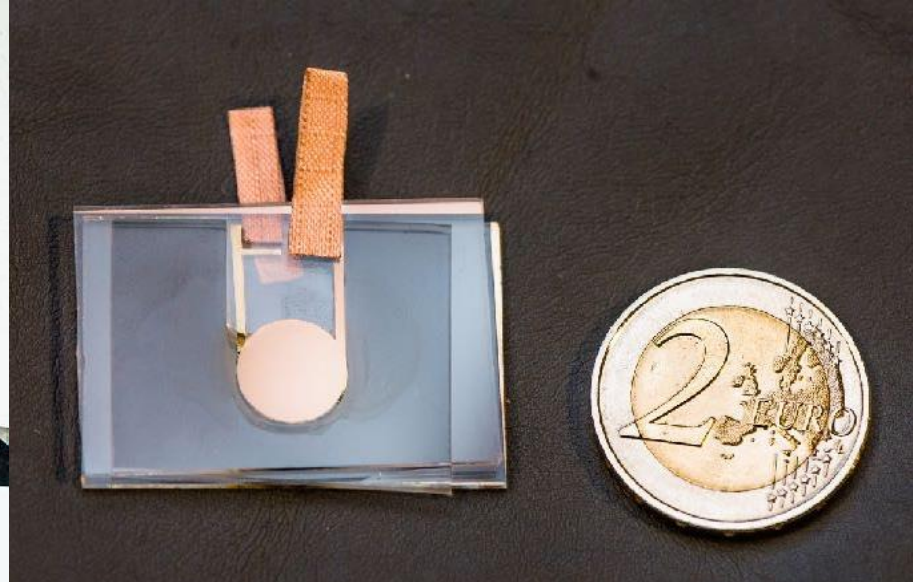
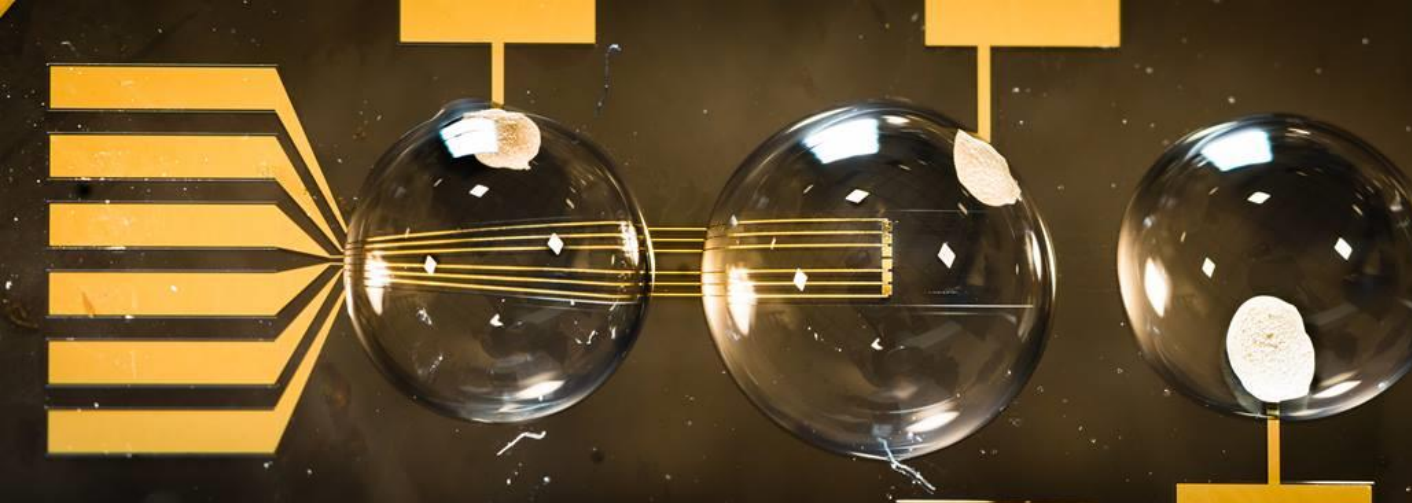


**Klas Tybrandt**  
Soft electronics

**Roger Gabrielsson**  
Chemistry





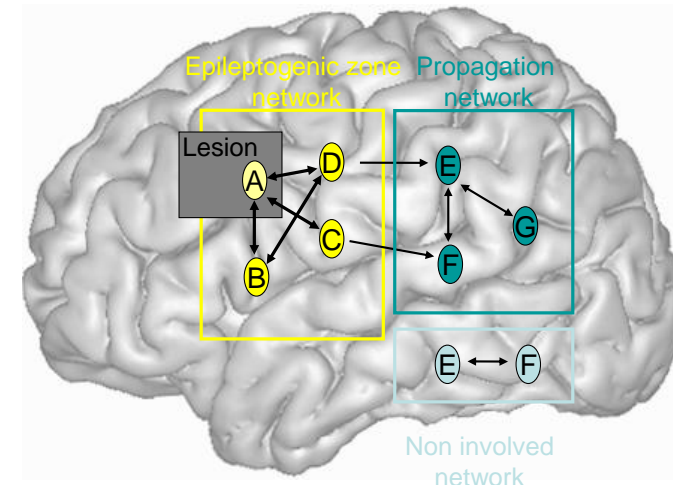
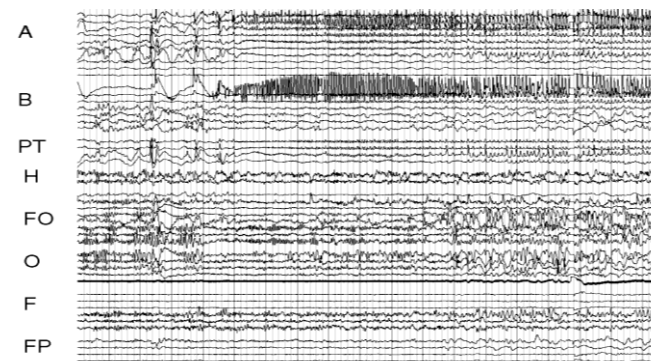






# Three main clinically oriented themes:

## Theme 1. Seizure genesis and propagation



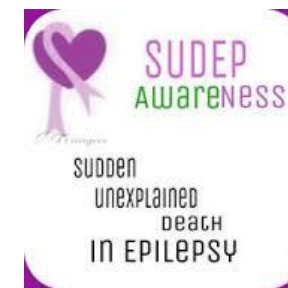
## Theme 2. Co-morbidities in epilepsy



Cognitive deficits



Depression



SUDEP

## Theme 3. Therapeutic approaches





# A multilevel & multidisciplinary approach

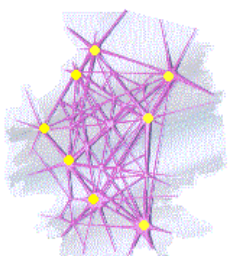


Behaviour

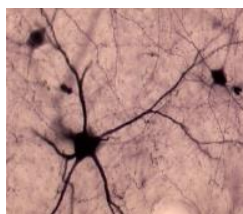
In order to answer some questions  
new technologies are needed



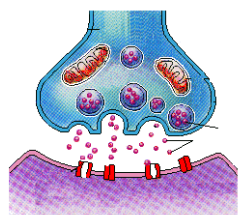
System  
Computational



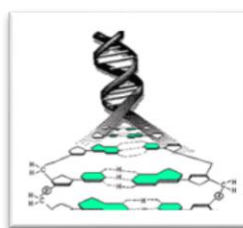
In vivo - in vitro  
Electrophysiology  
3D 2p imaging  
optogenetics



Functional  
morphology



Mol Biol  
Epigenetics



We will use the technologies developed  
In Epigraph to answer our questions

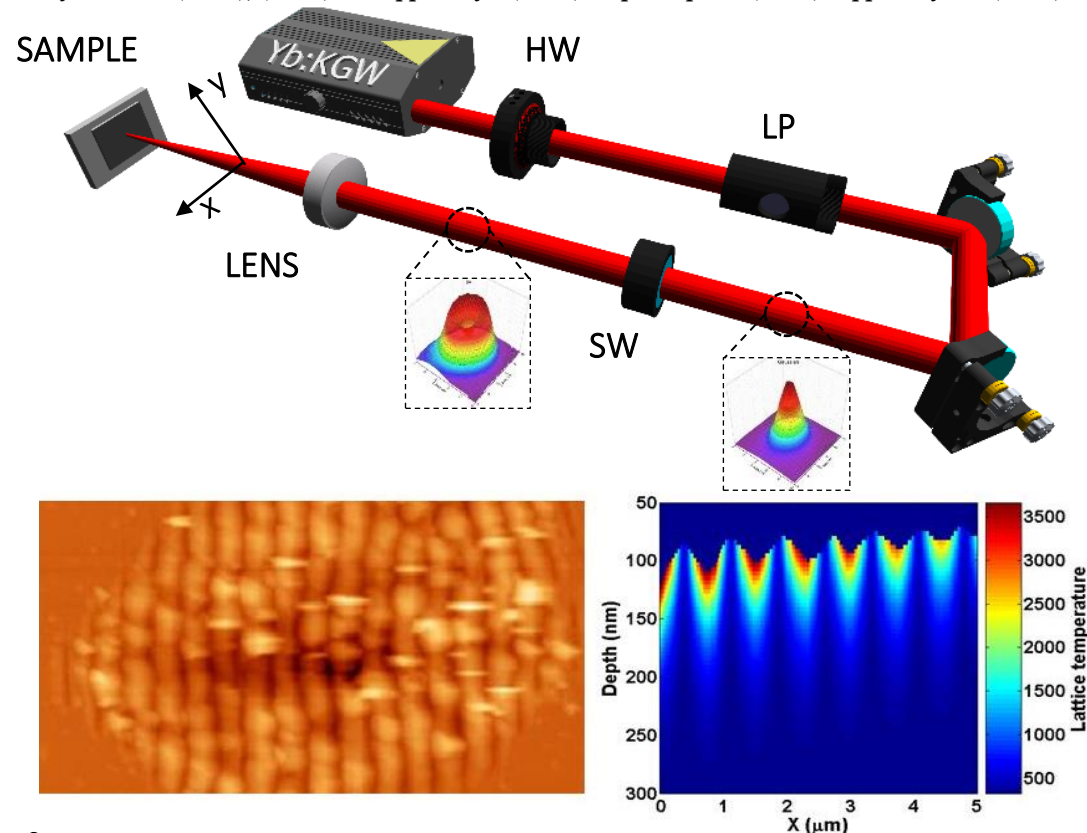
- Emergence of behaviour
- Network organization
- Cellular function
- Network architecture



# Fundamentals of Ultrafast Laser Processing

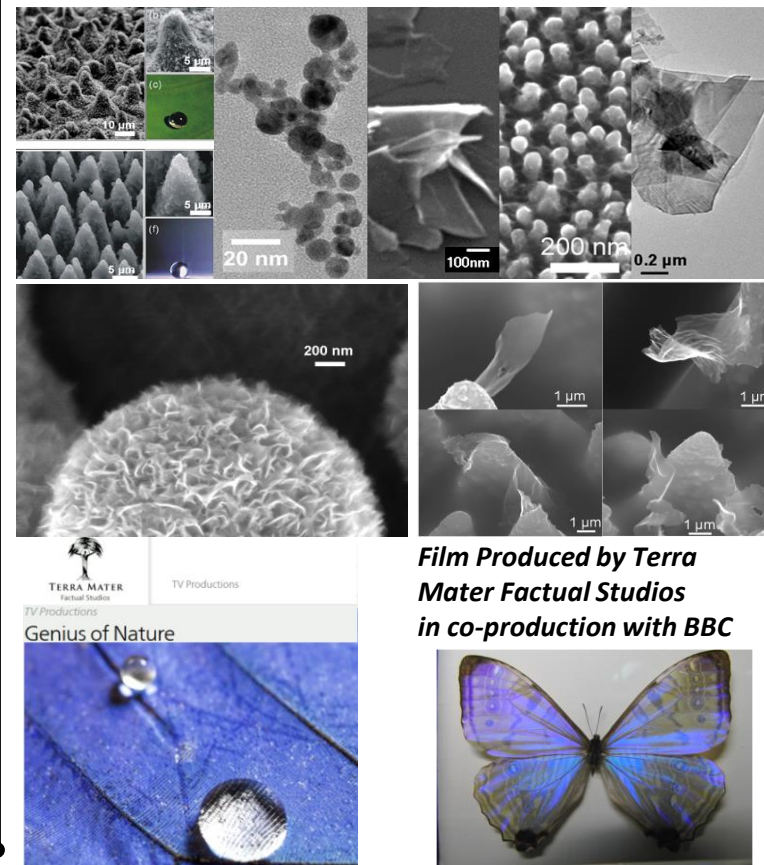
**in collaboration with G. Tsibidis (IESL)**

*Phys. Rev. B (2012), (2015) / J. Appl. Phys. (2012) / Opt. Express (2013) / Appl. Phys A (2014)*



## Biomimetic Micro/Nano Materials

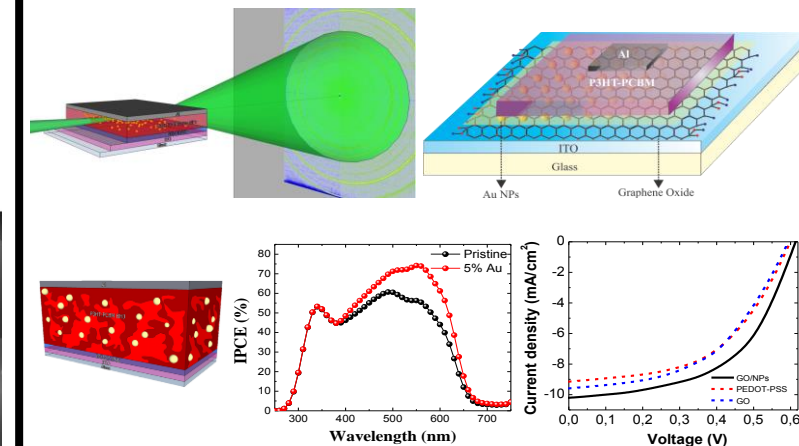
*Adv. Mater. (2008) / Sci. Adv. Mat (2012)/ Opt. Lett .(2015)*



## Organic Photovoltaic Applications

**in collaboration with E. Kymakis (TEIC)**

*Adv. Ener. Mater. (2016) / Nanoscale (2014)/ RSC Adv. (2013)*  
*Mat. Today (2013) / Adv. Mater. (2013)/ Chem. Comm. (2014)*



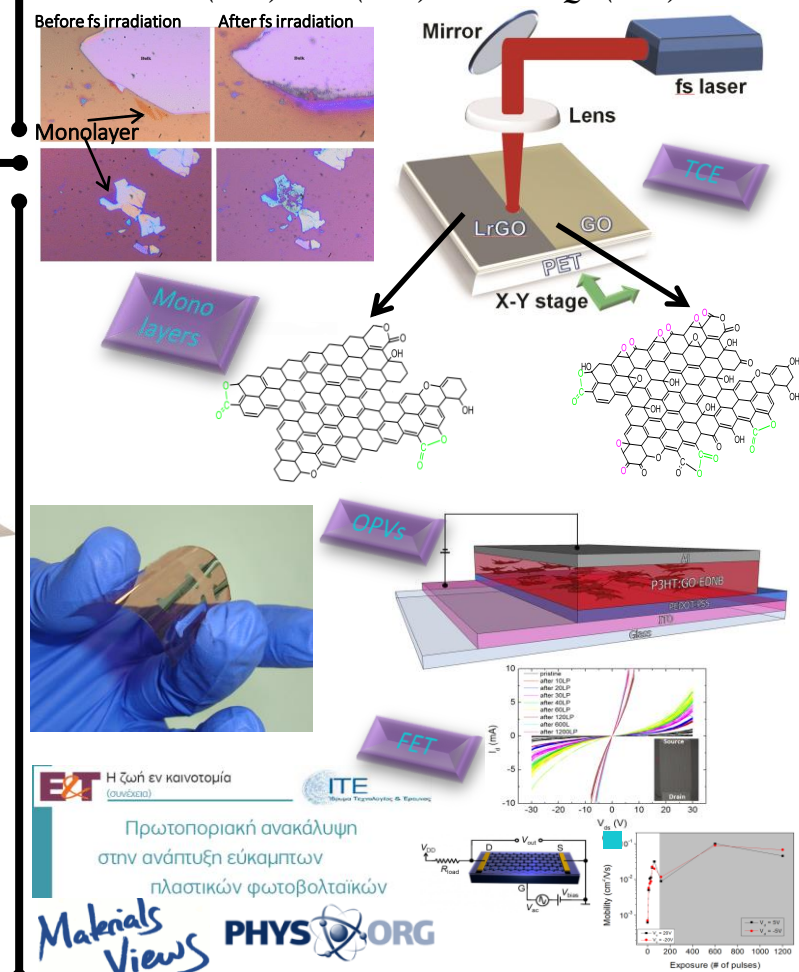
## Laser interaction with 2D materials

in collaboration with E. Kymakis (TEIC),

**T. D. Anthopoulos (ICL), G. Kiioseoglou (IESL)**

*Adv. Func. Mater.* (2013)(2015) / *Nanoscale* (2013)

*Carbon (2012) / APL (2013) / IEEE JSTQE (2014) /*

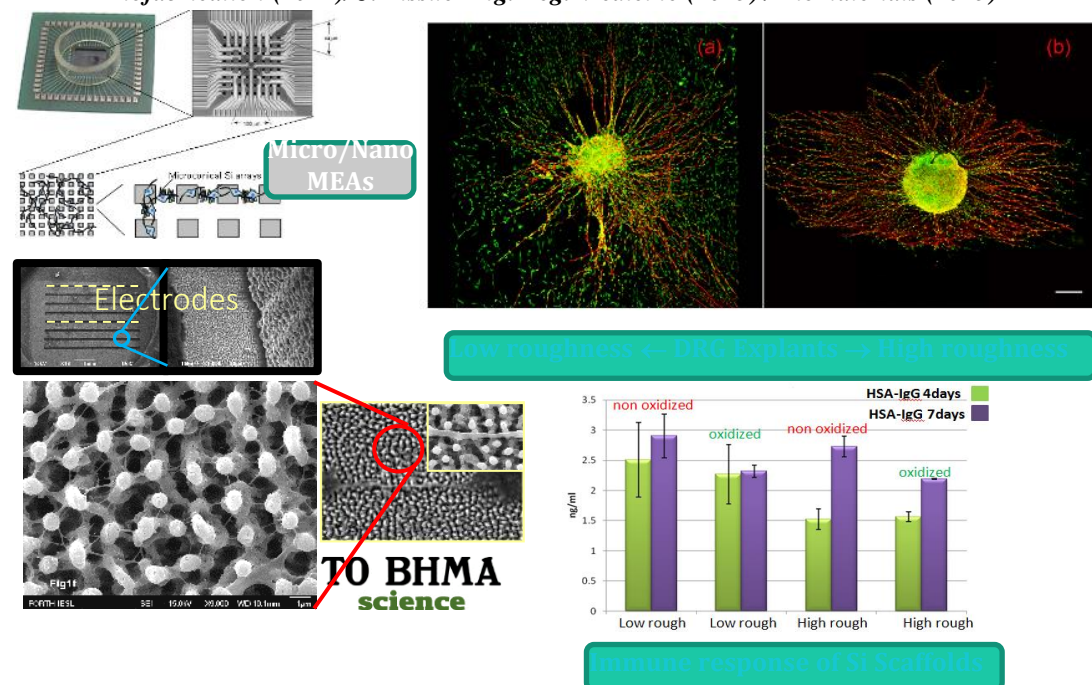


## Biological Applications

in collaboration A. Ranella (IESL), I. Athanassakis (UoC) and A. Gravanis (IMBB)

*Acta Biomaterialia* (2010) / *Tissue Eng. C* (2009)

*Biofabrication* (2011) / *J. Tissue Eng. Reg. Medicine* (2015) / *Biomaterials* (2015)



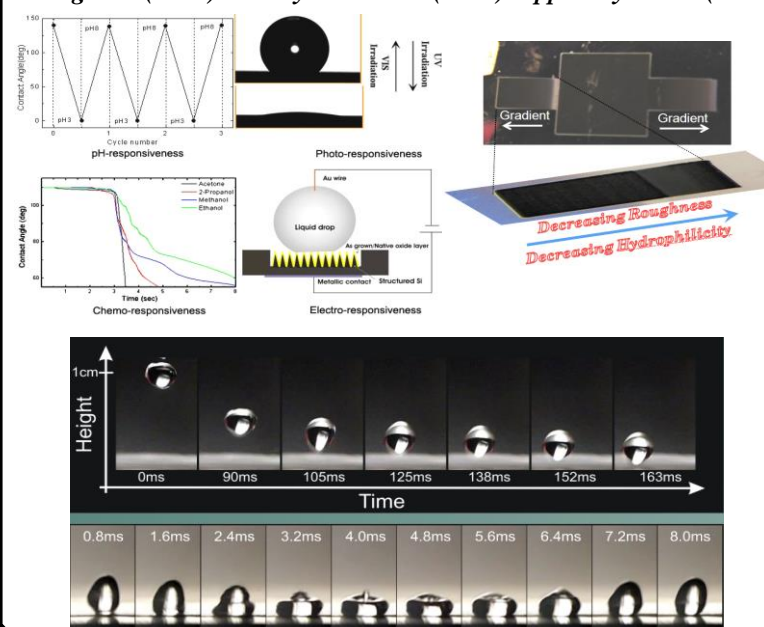
## Extreme Wetting and Microfluidics

in collaboration with M. Vamvakaki

**and S. H. Anastasiadis (IESL)**

***Biomicrofluidics (2010) /Chem. Comm. (2010)***

*Langmuir* (2011) / *J. Phys. Chem. C* (2009) / *Appl. Phys. Lett.* (2015)

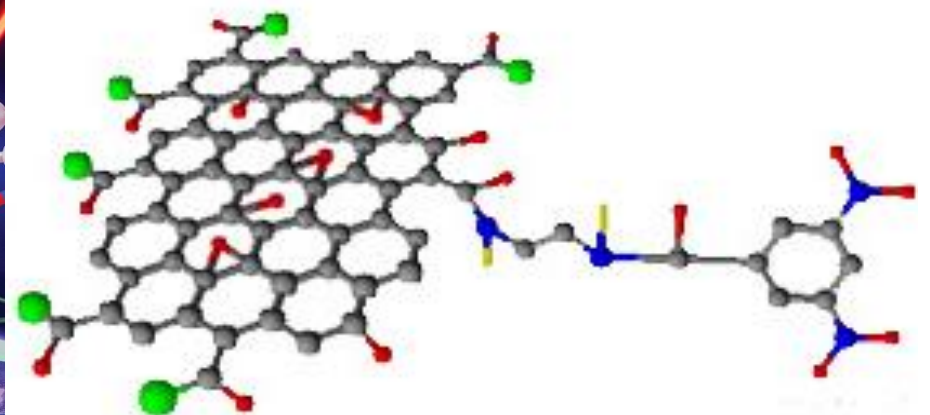
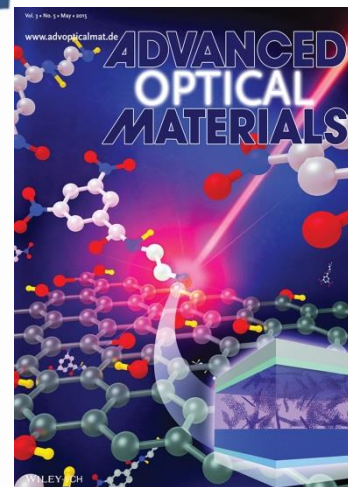
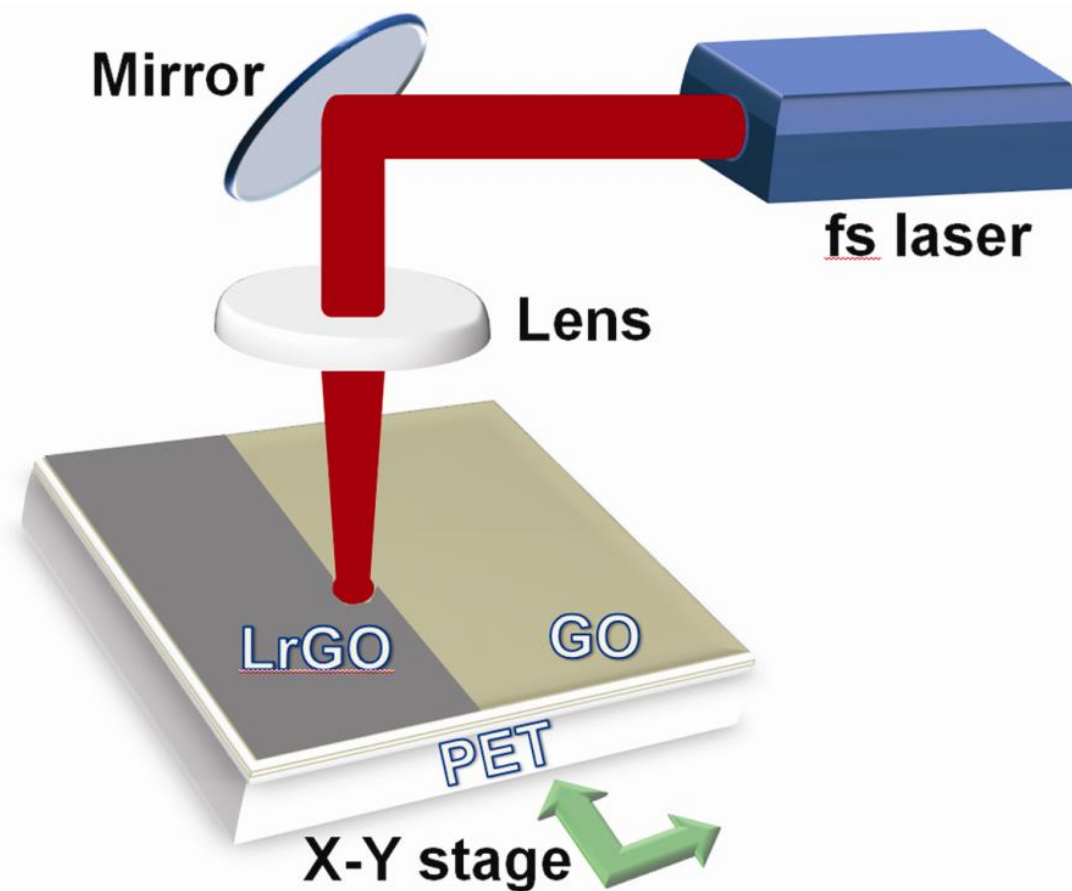




# Laser processing and functionalization of Graphene

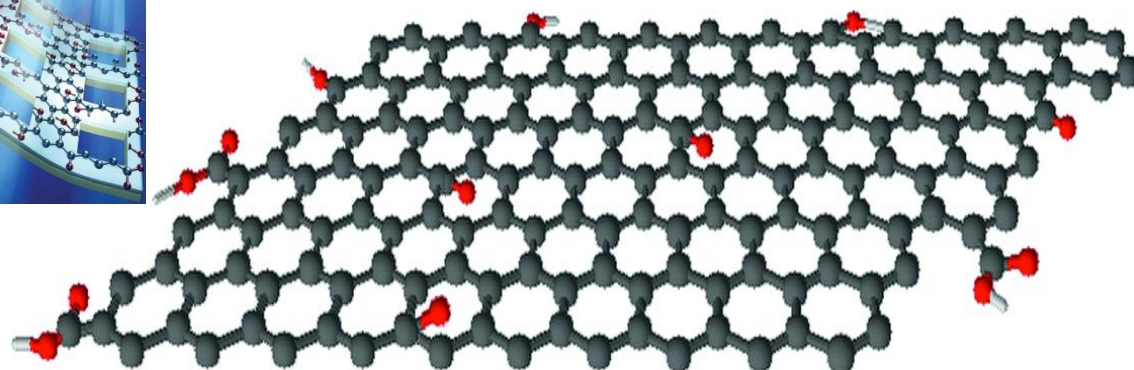
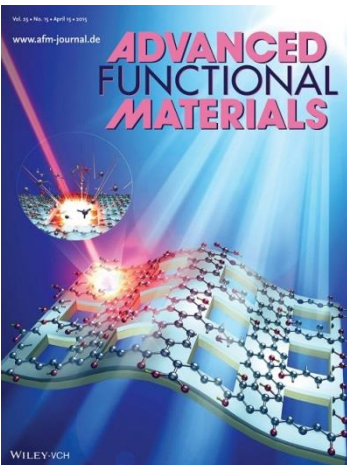


**SPG**



*Laser Functionalized SPG*

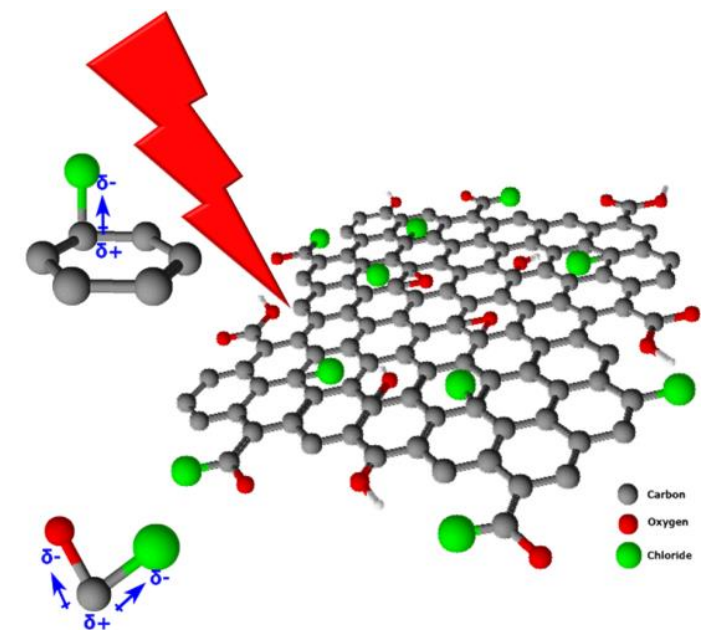
Adv. Opt. Mat. (2015), 3, 658



*Laser Reduced SPG*

Adv. Func. Mat. (2013) 23, 2742

Adv. Func. Mat. (2015) 25, 2206



*Laser Doped SPG with tunable WF*

Nanoscale, (2014), 6, 6925

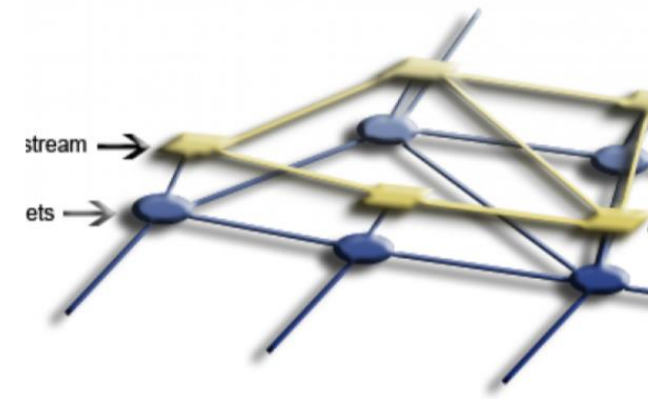




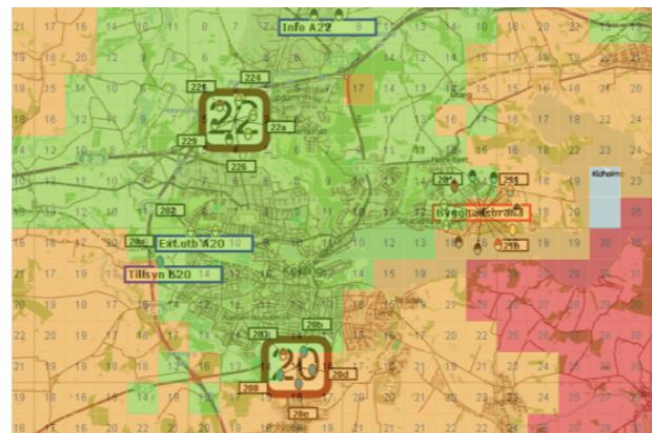
# RISE SICS EAST AB



Business Innovation  
Lars Hult – Business  
Innovation Manager  
Lars Hult är en så kallad



Coding and  
Communication  
Coding and  
Communication



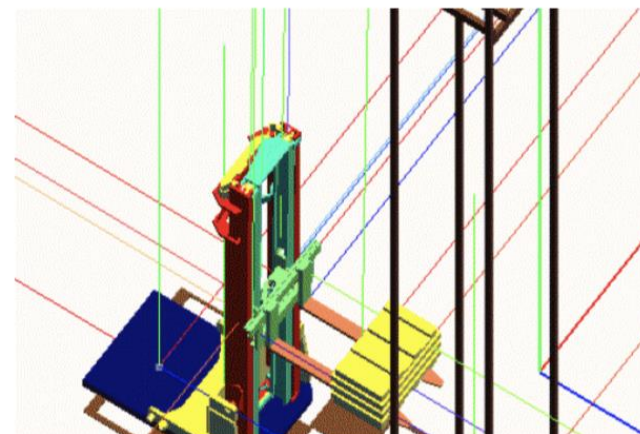
Crisis Management,  
Safety and Security  
The crisis management,  
safety and security



e-Society -  
Healthcare and  
Everyday Information  
Services

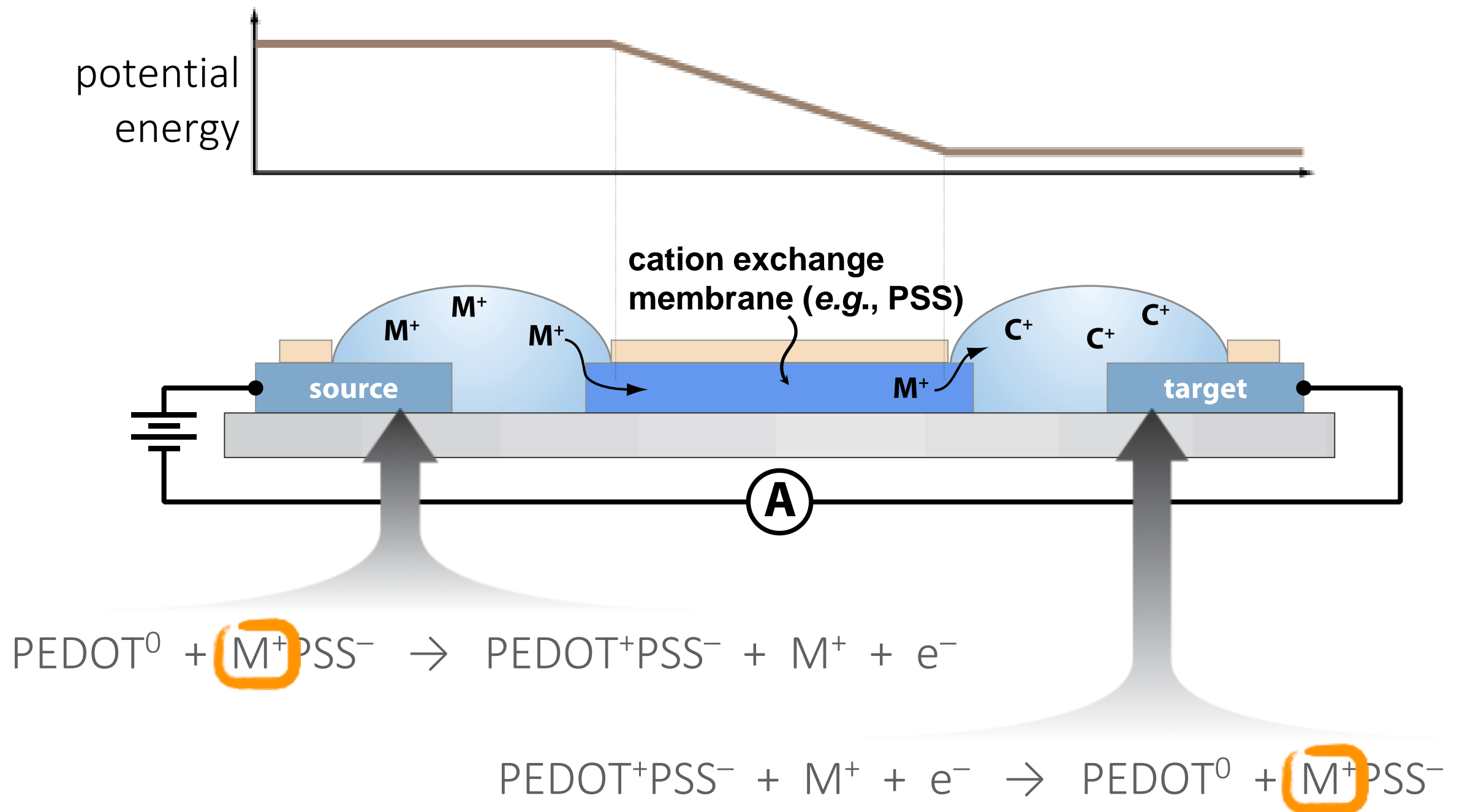


Language  
Technology and  
Intelligent Interaction  
Design



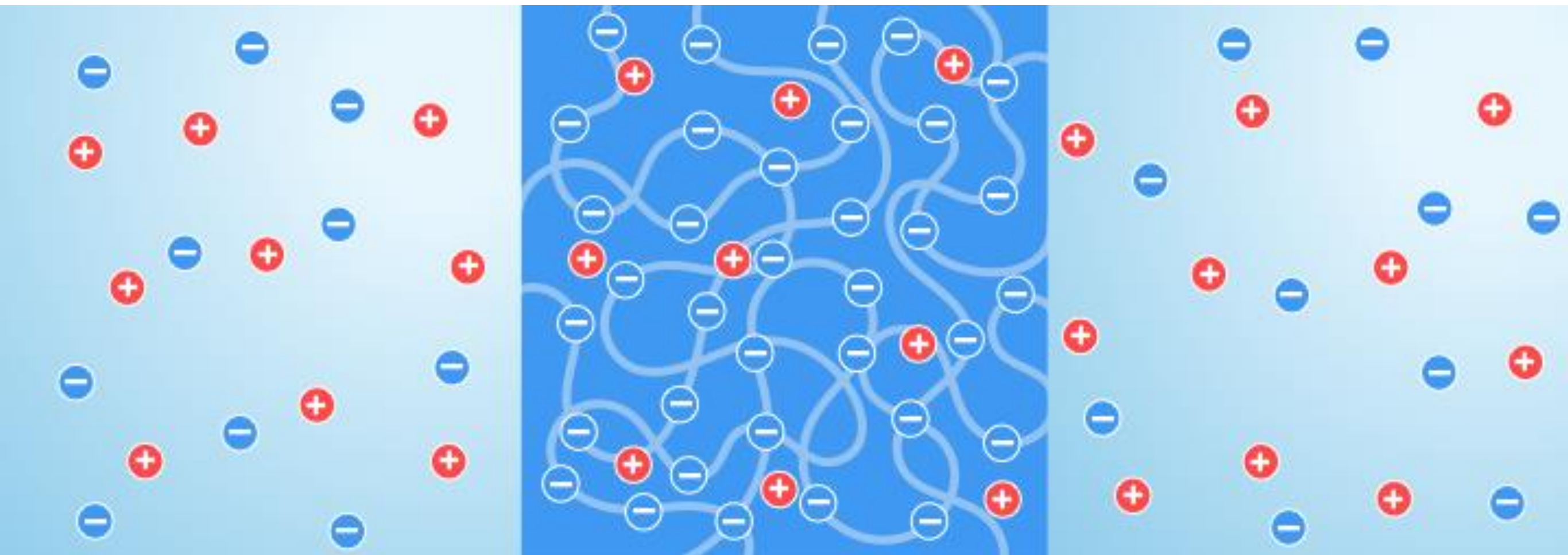
Software Engineering  
and Object Modeling  
The Software  
Engineering and Object

# Organic electronic ion pump

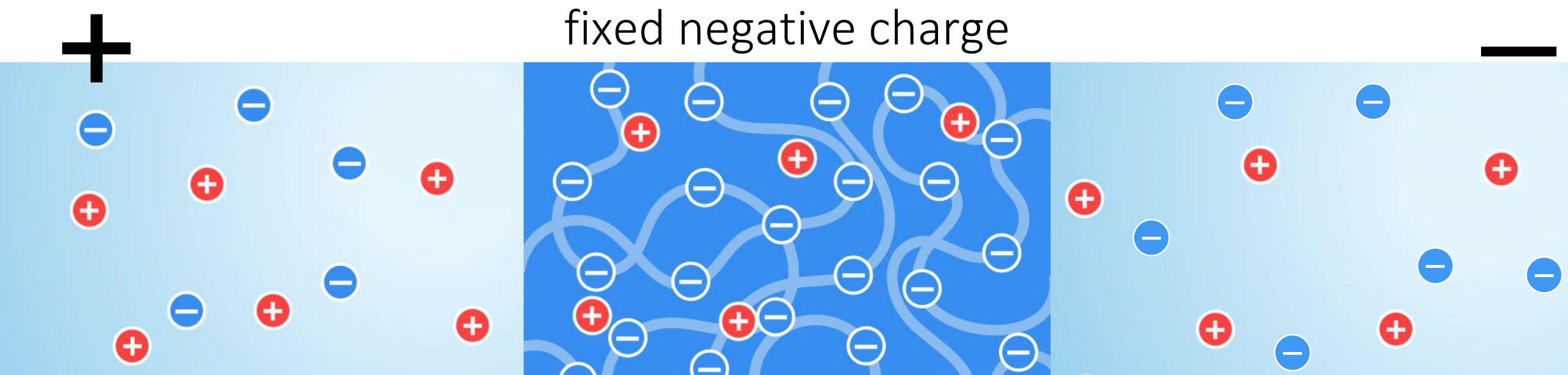




# Organic electronic ion pump



# Organic electronic ion pump

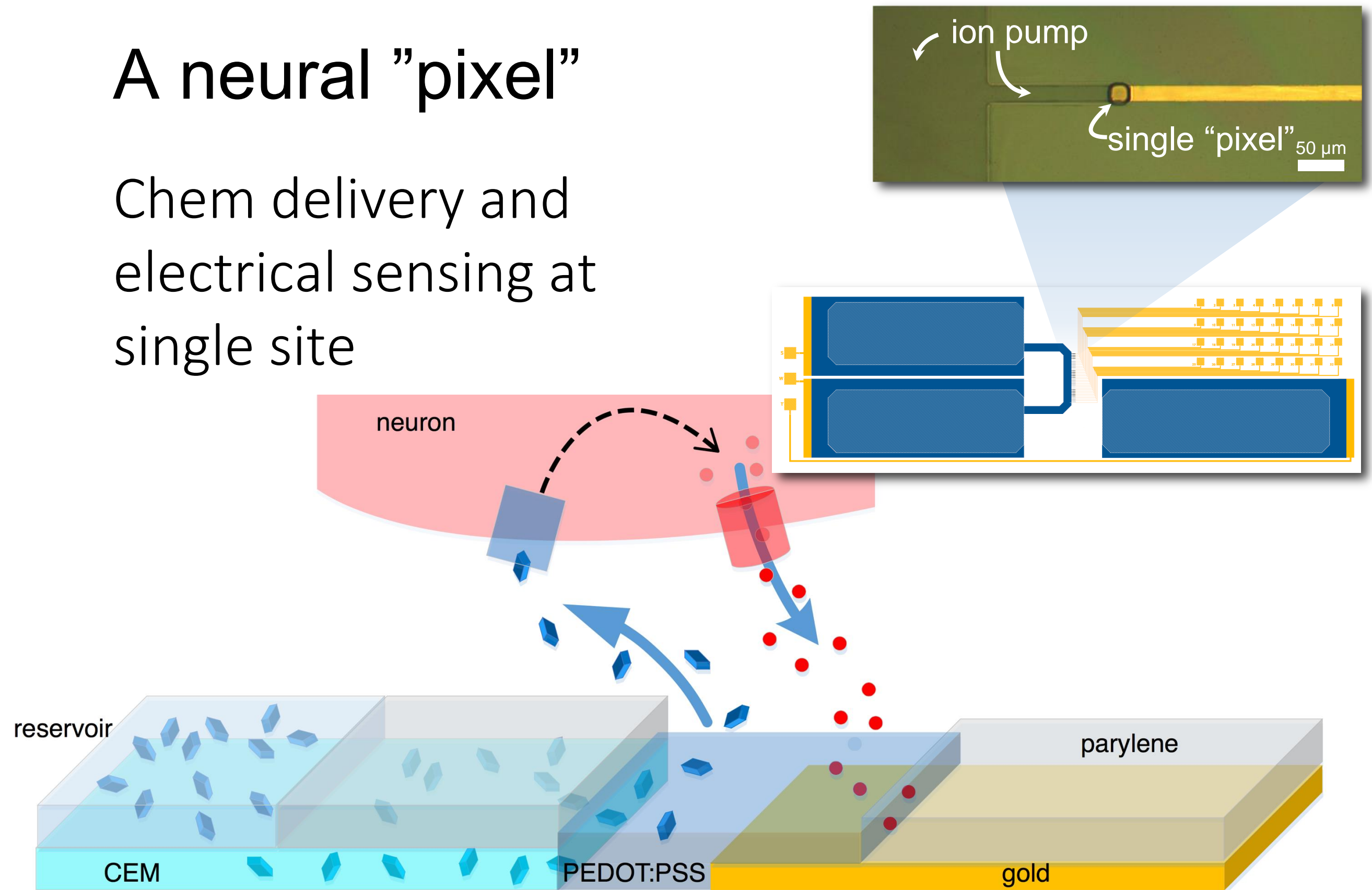


Ion, drug, therapy,  
neurotransmitter...



# A neural "pixel"

Chem delivery and  
electrical sensing at  
single site

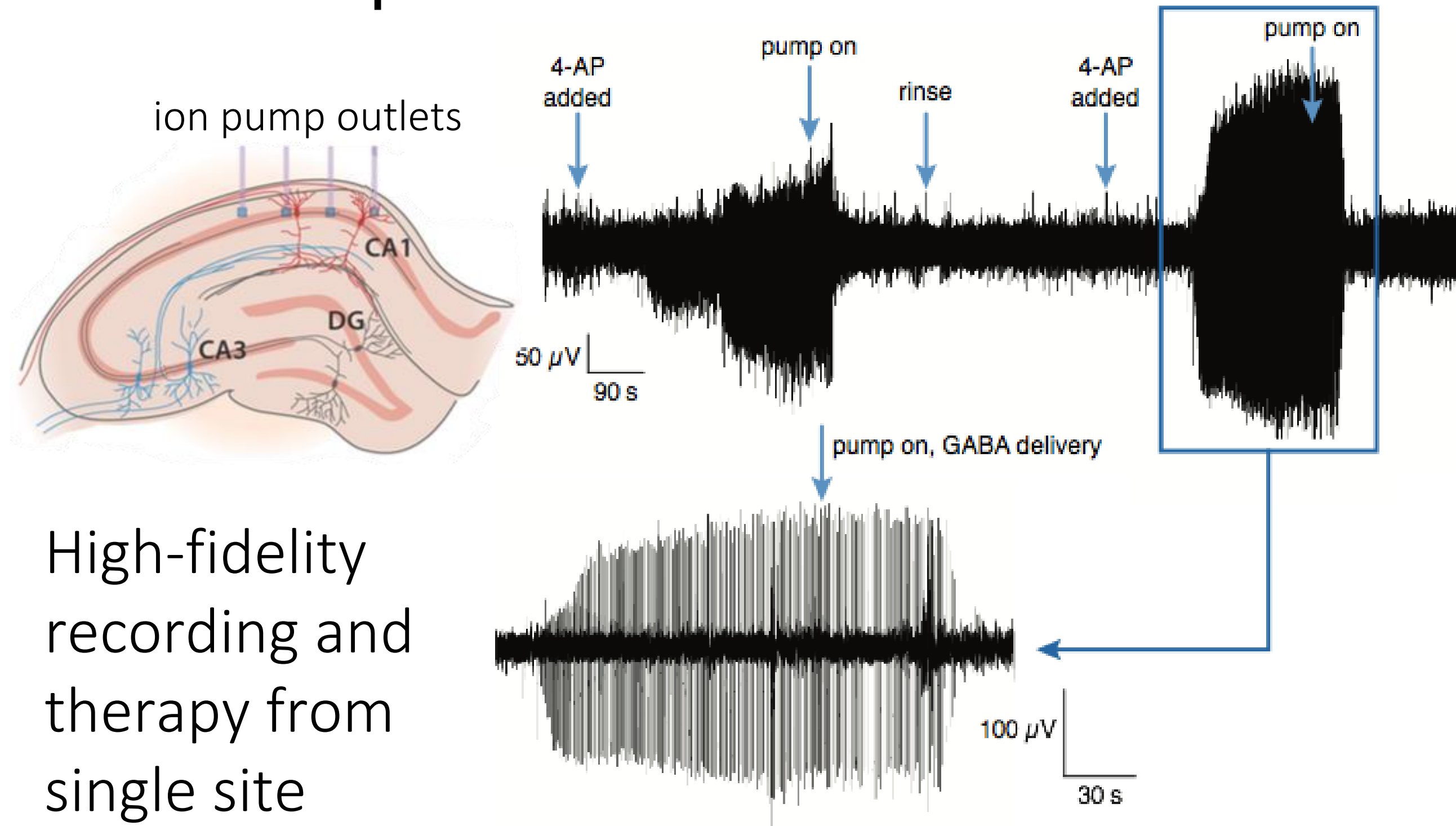


# Applications of the biomimetic neuron

| sensed<br>“input”              | delivered<br>“output” | application   |
|--------------------------------|-----------------------|---|
| Glu                            | GABA                  | Epilepsy  |
| Glu                            | Glu, ACh              | Spinal cord injury, restoration<br>of muscular activation |
| Dopamine                       | Dopamine              | Parkinson’s disease                                       |
| <i>electrical<br/>activity</i> | GABA                  | Epilepsy  |



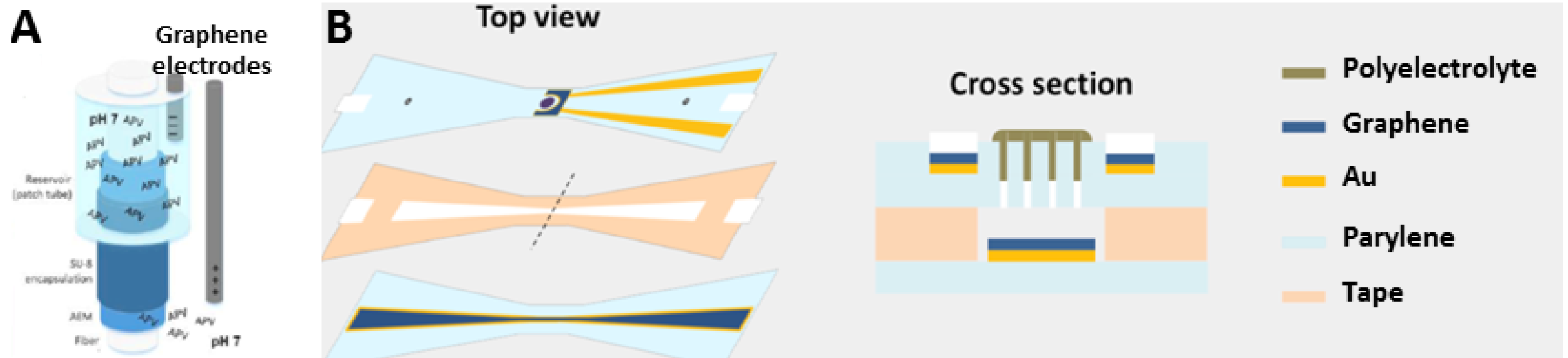
# A neural "pixel"



High-fidelity  
recording and  
therapy from  
single site

# THE 'EPIGRAPH' CONCEPT

*GRAPHene biomolecular and electrophysiological sensors integrated in an “all-in-one device” for the prediction and control of EPileptic seizures*



- **WP5** 'Biomedical Technologies'
- **WP6** 'Sensors'



FLAG-ERA



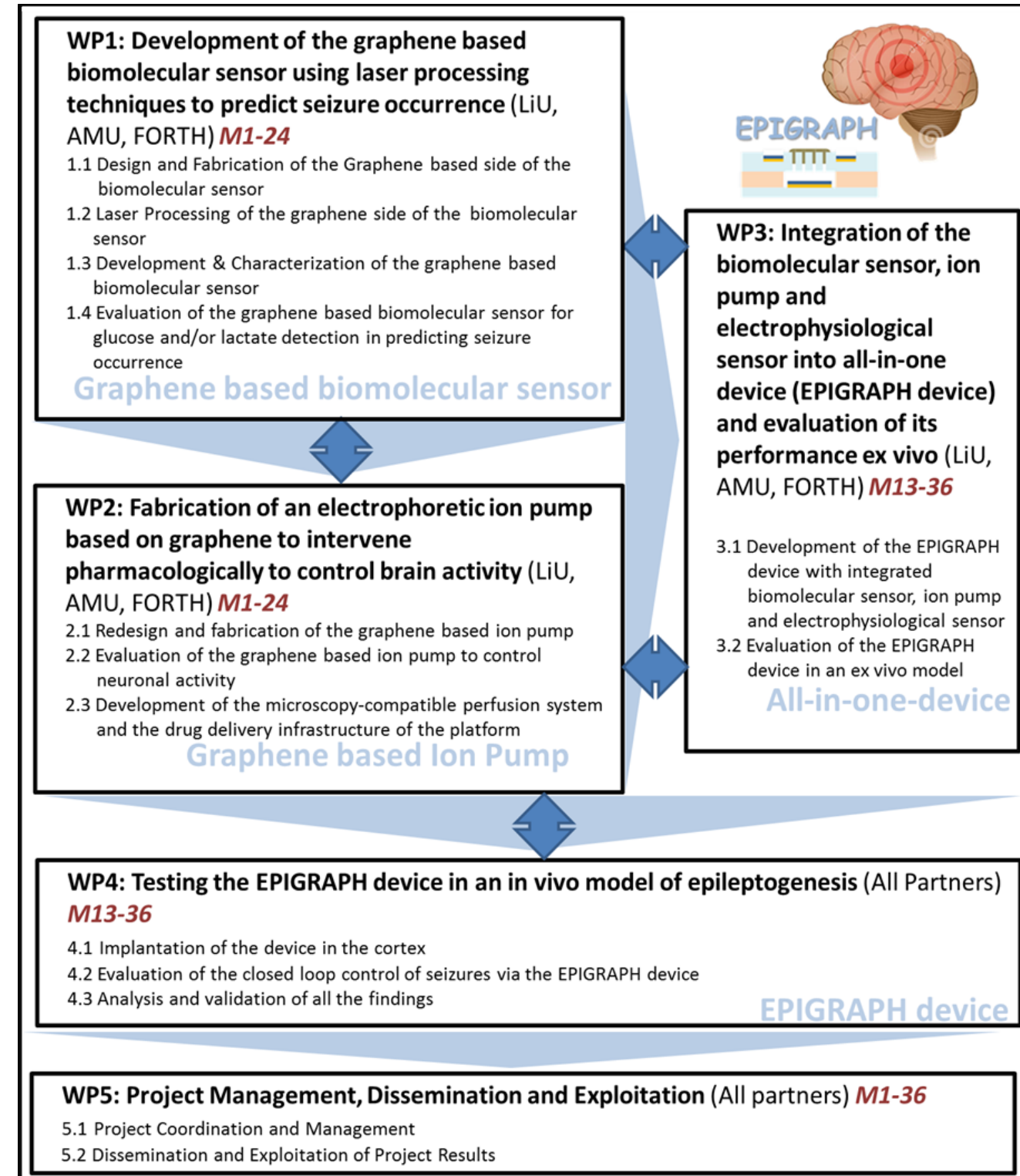
GRAPHENE FLAGSHIP





# THE EPIGRAPH STRUCTURE

| Partner | Main Task                        |
|---------|----------------------------------|
| LiU     | Ion Pump Technology              |
| AMU     | Biosensors and Electrophysiology |
| FORTH   | Laser Fabrication                |
| RISE    | Tech Transfer                    |



# Technology Transfer:Regulatory aspects on EPIGRAPH

Design & development of intervention platform & tools for brain disorders; a high risk – high reward medtech project

- Management of risks is central in all drug/device development projects
- Analysis and management according to harmonized standards such as ISO14791 for medtech-products required
- Risk mitigation, and verification of such actions, to reduce risks as far as possible, for the patient, the medical staff involved, and all that are involved in any part of the product life cycle
- Finally, when the product is used in the clinic, the risks associated with the product and its use must be acceptable when considering the benefits for the patient.
- **The resulting risk-benefit ratio is a factor to consider at all stages of the development project**



# EPIGRAPH: CURRENT STATUS

- Submission and approval of Graphene Flagship Partnering Project Application
- Kick off meeting, Norrköping, Feb. 7-8