

**HUMAN++**  
Pioneering efficient healthcare



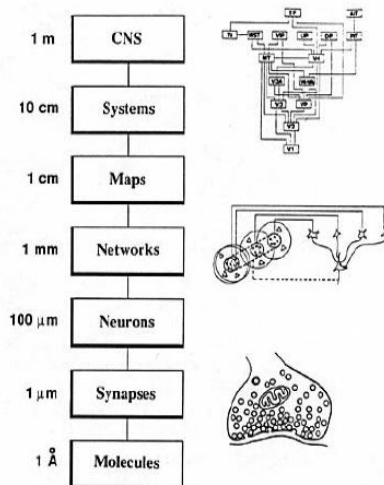
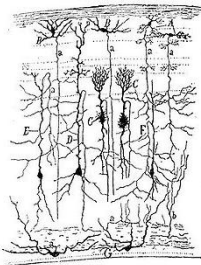
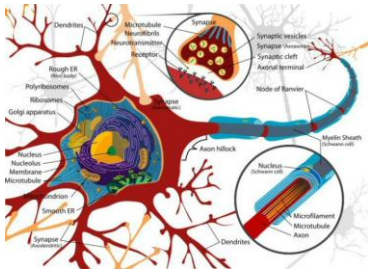
## CELLEN EN CHIPS

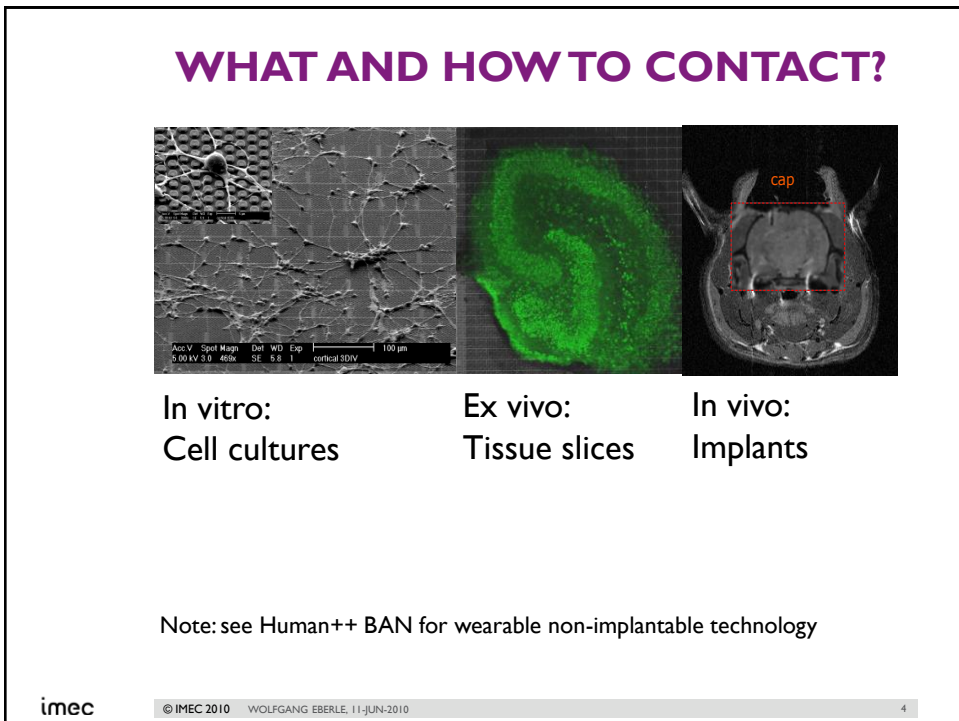
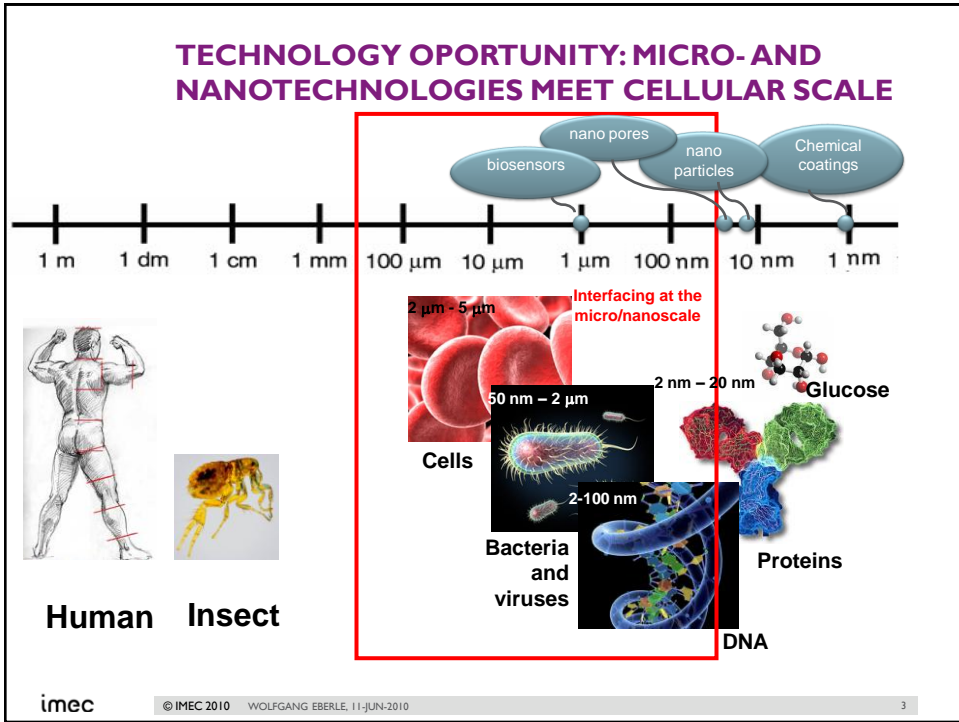
**DR. IR. WOLFGANG EBERLE**

SYMPOSIUM DUURZAME ONTWIKKELING IN ZIEKENHUIZEN  
EN WOON- EN ZORGCENTRA, 11 JUNI 2010



## WHAT IS THE RIGHT LEVEL FOR UNDERSTANDING BRAIN BEHAVIOR AND CURING NEUROLOGICAL DISORDERS?







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# CHRONISCHE EFFICIENTERE GENEESMIDDELEN TOEGEDIEND OP KLASSIEKE (ORALE) MANIER

## Vertretpunt

- Zoektocht naar effectievere geneesmiddelen

## Achtergrond

- Bestaande geneesmiddelen bestrijden symptomen maar verliezen hun effectiviteit over tijd
- Nood aan *in vitro* onderzoek om het gedrag van neuronale netwerken te bestuderen over langere tijd
- Nood aan *in vitro* platform om elektrische of scheikundige interacties met neuronen nauwkeurig (tijd, ruimte) te bestuderen

## Ontwikkelingstraject

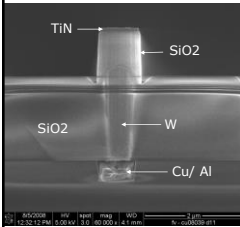
- Bioelektronische *in vitro* platform voor labotesten
- Studie biocompatibiliteit (overleven neuronen) van deze platform
- Ontwerp relevante assays (tests) om de effecten van kandidaat-geneesmiddelen op neuronen te bestuderen
- Optimalisatie van geneesmiddelen op basis van deze assays
- Studie invloed van opnamemechanisme

Eindpunt = demonstratie van het principe  
 Buiten beschouw hier: Klinische evaluatie

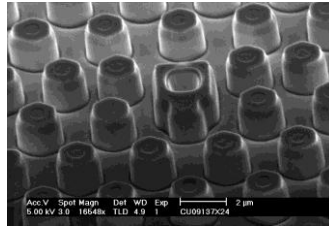


Labotesten: *in vitro*

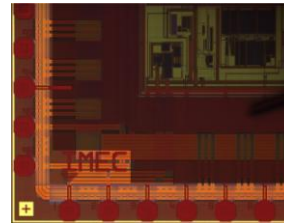
## IN VITRO DRUG SCREENING & DEVELOPMENT STEPS TOWARDS AN AUTOMATED LAB SYSTEM



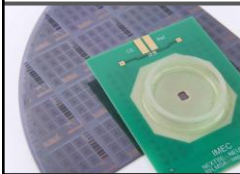
Transducers:  
Above-IC processing



Transducer heterogeneity  
Chip design



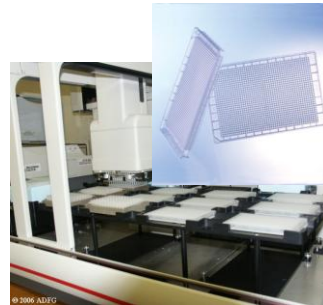
CMOS electronics design



- Wafer-scale processing
- Dicing
  - Biocompatible packaging

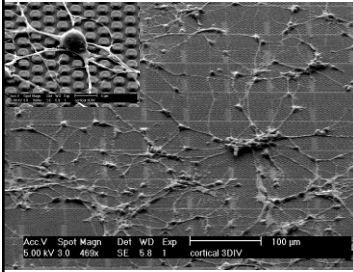


Setup integration



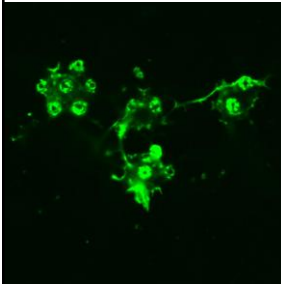
## imec *in vitro* chips

## INTERACTION AT NETWORK SCALE WITH SINGLE-CELL RESOLUTION

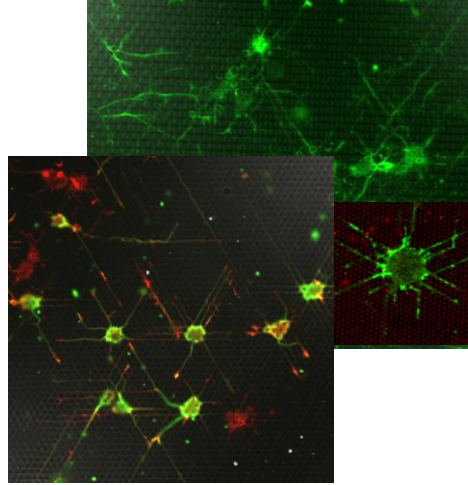


Massively parallel interaction with cells

Cell taxis: guidance of network growth



Engulfment: Single-cell addressability



Joint research with VIB

W=1.6, S=1.6

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## ELEKTRISCHE STIMULATIE IN DE HERSENEN MET FEEDBACK

### Vertrekpunt

- ▶ Verbeteren van monitoring van de effectiviteit van de behandeling (stimulatie) en aanpassen van de stimulatie

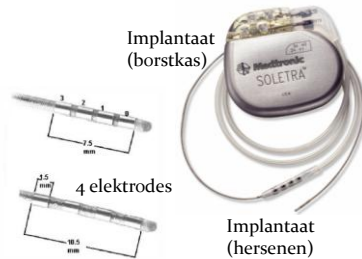
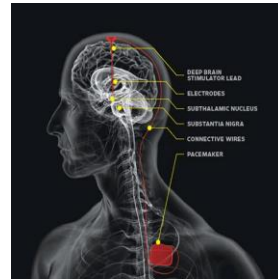
### Achtergrond

- ▶ Huidige stimulatiesystemen hebben geen terugkoppeling
- ▶ Verhouding gewenst effect vs ongewenste neveneffecten wordt vandaag niet voldoende opgevolgd
- ▶ Ruimtelijke selectiviteit is klein (oorzaak van neveneffecten)

### Ontwikkelingstraject

- ▶ Ontwerp implantaat met gepaste elektrodetopologie
- ▶ Ontwerp elektronica voor stimulatie en monitoring
- ▶ Studie actie-reactie in *in vivo* experimenten
- ▶ Ontwikkeling controlestrategie (-> therapie)

Eindpunt = demonstratie van het principe  
Buiten beschouw hier: Klinische evaluatie



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**WWW.NANOSOC.BE**

How to set-up roadmaps with all parties information involved in the decision process?

How to involve citizens in the process?

How to activate the chain of not directly involved parties (e.g. in the medical domain: patients, patient organizations, regulation bodies, health insurance)

How to link researcher's motivation, innovation, and roadmaps?

How to involve the citizen in the researcher?



**... in three nanodomains**

Bio-on-chip	Smart environment	New Materials
<p><b>(or Bioensing):</b> creation of interactions between biological material (cells) and micro-electronic components (chips).</p>	<p>Information technology brings efficient and faster digital tools the design of the "Anything Anywhere" device through challenges in battery life-time, cost complexity, user experience.</p>	<p>Mesoporous materials and nanomaterials provide new specific characteristics that can lead to the optimal development of a wide range of applications.</p>
<p><b>Main technological challenge:</b> combine the biological and micro-electronic components at the micro and nanoscale.</p>		<p><b>Key enable:</b> ZnO on MgO</p>

[IWT SBO NanoSoc 2006-2010]

