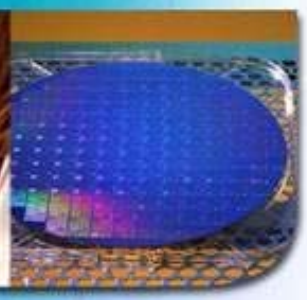
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2012

Biocompatible multielectrolyte sensors

J. Fils - julien.fils@cea.fr





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Outline

- Artificial organs: artificial kidney
- Novel device – novel sensors
- Sensor performances
- Advantages
- Calibration
- Development of the sensors

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Artificial organs: artificial kidney







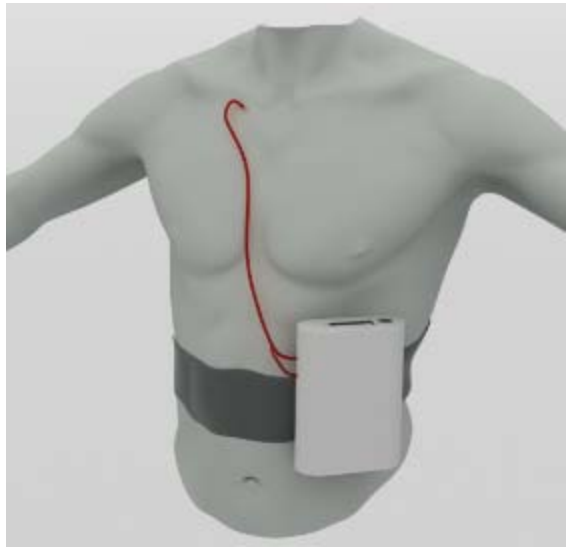


- Development a next generation **ICT** enabled **Renal Care solution** for personalized treatment and management of patients with chronic renal failure, outside hospitals **on any location while being mobile and active** in their daily life.
- FP7 European project
- Partners: CEA-LETI (fr), Nanodialysis (nl), TNO (nl) and Krems University (au)

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Artificial organs: artificial kidney





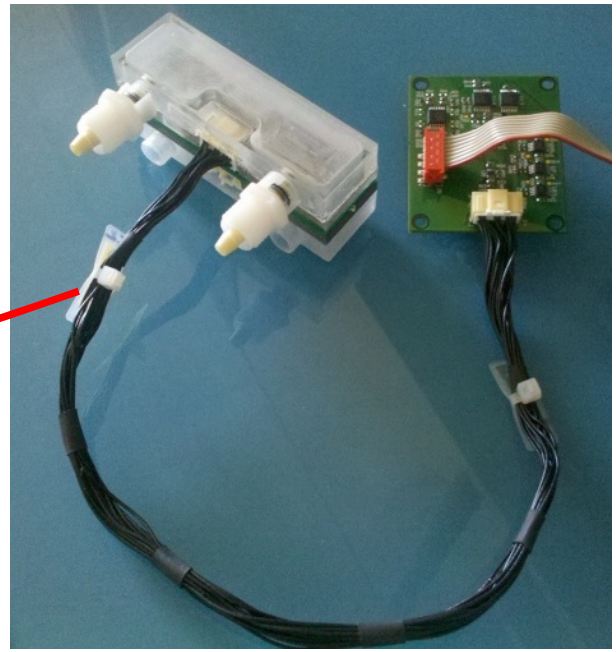


- Hemodyalisis treatment
- Can be a 24/7: better for the patient (extended lifetime and mobility)
- A large cost reduction

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Novel device – novel sensors



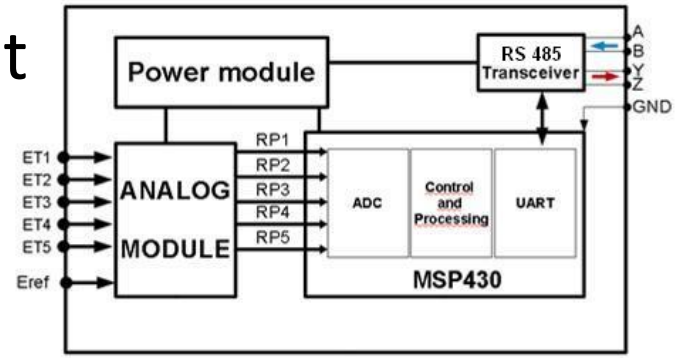


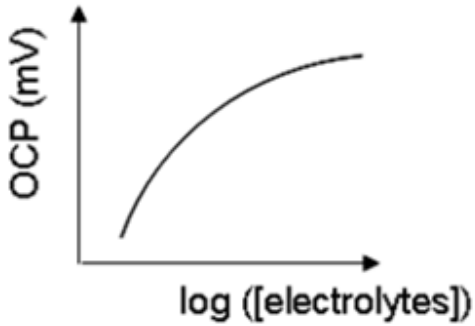
- Electrochemical platforms (before and after the sorbent unit) to monitor the concentrations of K+, Ca++ and pH
- It gives the input of the loop control and the health condition of the patient

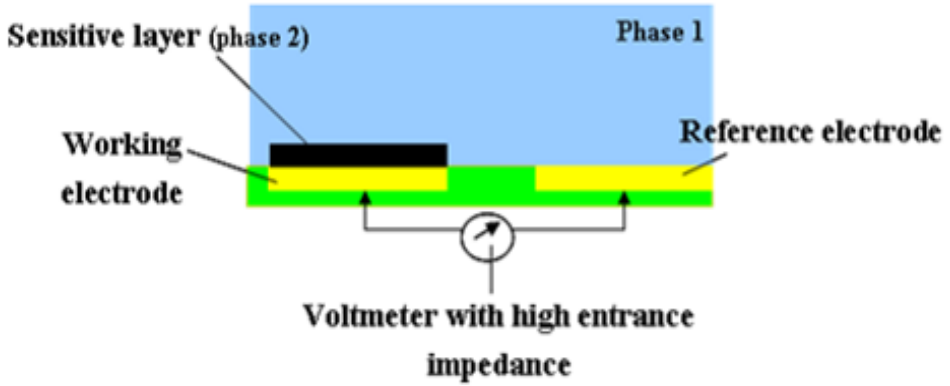
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Novel device – novel sensors

- Electrochemical measurement principle: the Open Circuit Potential







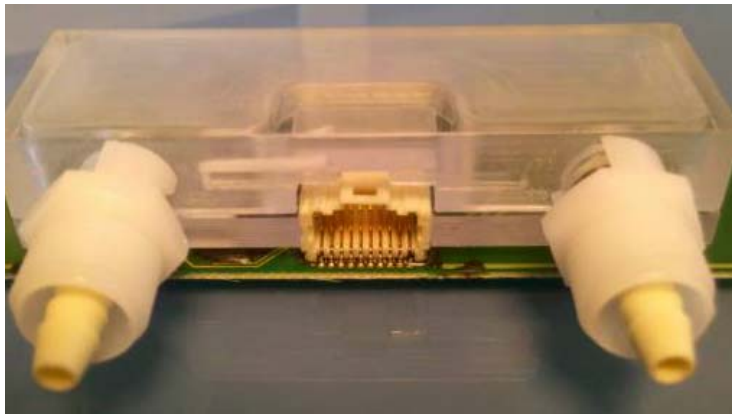
- The electronic manages the sensors and converts the potential into concentration

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Novel device – novel sensors

- The **fluidic connectors** are standard medical connector: the nurses and the physicians are used to work with such system and they are already approved

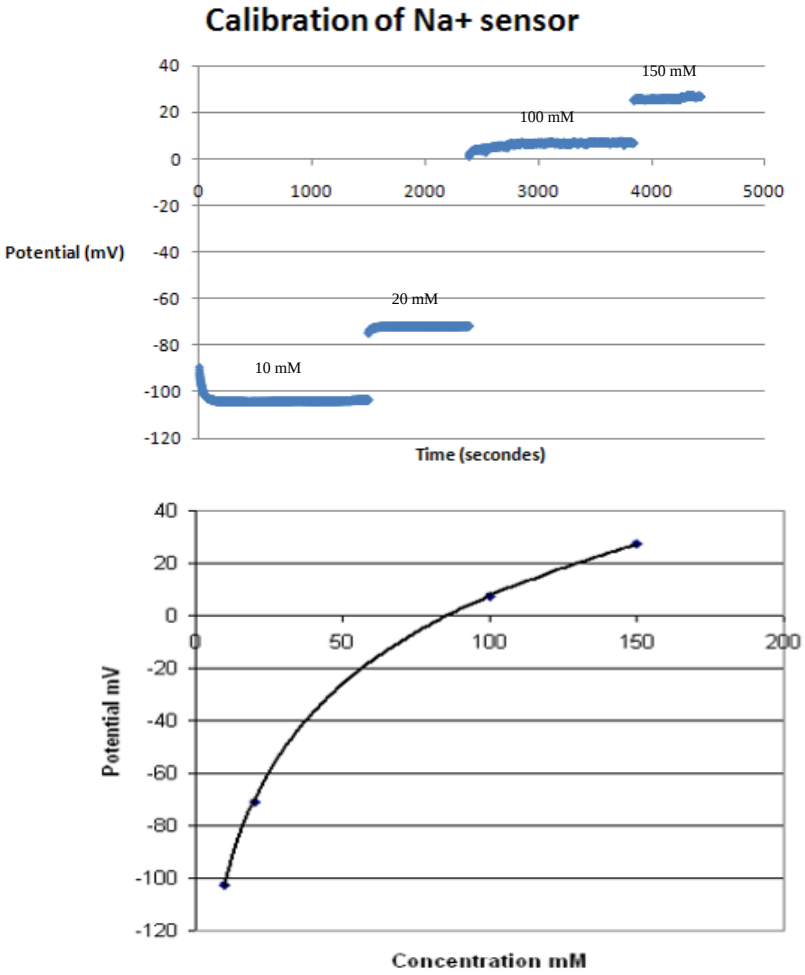




- The **electrical connector** have been selected to be easily plugged/unplugged by the patient and the medical staff

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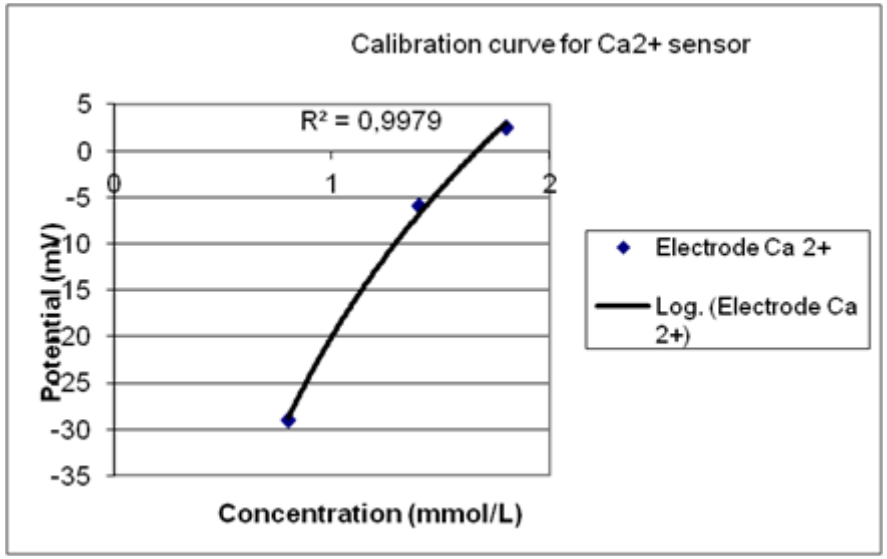
Sensor performances



Na+ sensor	**Dialysate**
Dynamic range	10-150mM
Precision	< 2 mM
Accuracy (deviation from reality)	±2%
Response time	< 1 minute

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Sensor performances



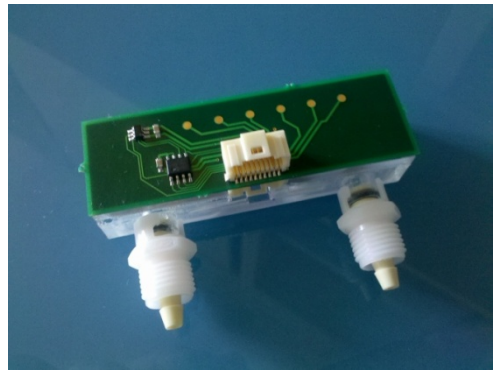
Ca2+ sensor	**Dialysate**
Dynamic range	0.5 – 4 mM
Precision	0.05
Accuracy (deviation from reality)	±1%
Response time	<1 minute

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Advantages

1- Size





- A commercial sensor is 15 cm high with a diameter of 1,5 cm (26 cm^3)

⇒ The new design is 0,4 x 0,4 x 0,4cm (0,1 cm3)

⇒ The surface of the electrode can be decreased up to 500 µm

⇒ The minimum volume for three sensors is 20µL

2- Multiparametric

- A multiparametric platform with a number of sensors according to the application

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Advantages

3- Biocompatibility

Cytotoxicity results

Sensors	Cells NIH 3T3 viability (%)	Toxicity according the standard ISO *
Na+	85	slight
pH	86	slight
K+	83	slight
Ca++	89	slight

Hemolysis results

Sensors	Hemolysis (%)	Admited hemolysis according to the standard ISO*
Na^+	< 5	5
pH	< 5	5
K^+	< 5	5
Ca++	< 5	5

* **Standard ISO 10993-11**

- Experiments done in direct contact but also in conditioning with 3T3 cells (very sensitive)

4- Sterilization

- Unlike the commercial sensors, this platform can be sterilized by ETO (ethylene oxide)

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Advantages

5- Extended lifetime

- The storage of this platform is for several **months** (commercial sensors: 6 months) at room temperature on the shelf
- The usage time has been increased from couple of hours to more than one week keeping the same characteristics

6- Ion interferences

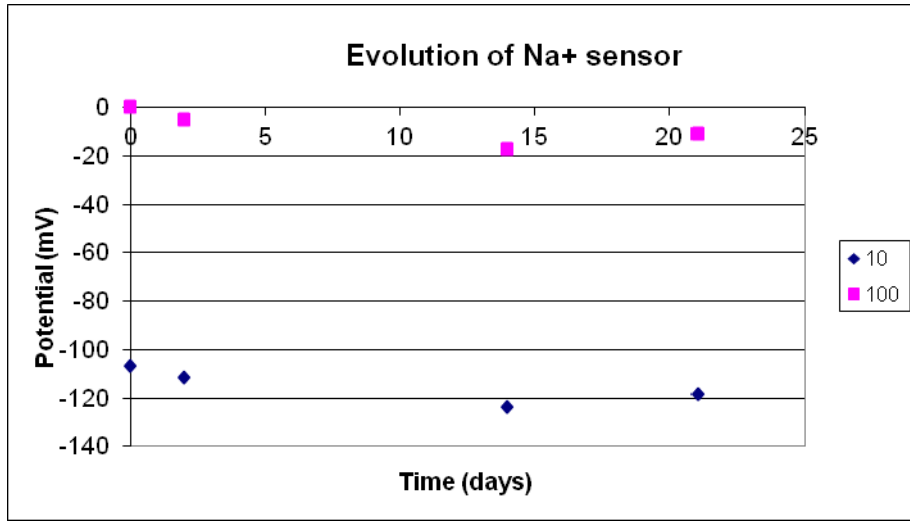
- The possibility to have a multiparametric platform allows to avoid any kind of interference between the ions

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Calibration

- Based on the stability of the sensors, a method with only **one point measurement** is needed to calibrate the sensor (in the Good Laboratory Practice, it is usually three points)
- A pattern technology allows to **avoid calibration** before using: the calibration is no more requested

Day	D0	D2	D14	D21
10	-107	-111,7	-124	-118,5
100	0	-5,3	-17,3	-11
dynamique	107	106,4	106,7	107,5



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Development of the sensors

- Currently, several sensors are completely ready: Na^+, K^+, pH and Ca^{++}
- In a close future, glucose and Cl^- will be added to the list
- The development of several others sensors is in progress: F^-, $NH4^+$ and urea

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Development of the sensors

- Several applications need additional sensor:
  - Artificial liver (FP7 Dliver)
  - Point of care
  - Intensive care
- But also applications in the industry or in the environment (water quality)

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Thank you

Innovation for industry

J. Fils - julien.fils@cea.fr

Loyalty
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