ENOBIO

Aplicaciones de la Nanotecnología en la Medida de Biopotenciales

Dr. Esteve Farrés

Starlab

Starlab®

ENOBIO Introduction.

- Originally developed with the help of the FP6 EU funded IP SENSATION.
- The aim of the project was to develop technology for the monitoring of sleepiness and sleep related problems.
- ENOBIO was conceived as a solution to the problem of unobtrusive electrophysiology recordings. EEG (Brain Waves) and ECG (Heart Beat).

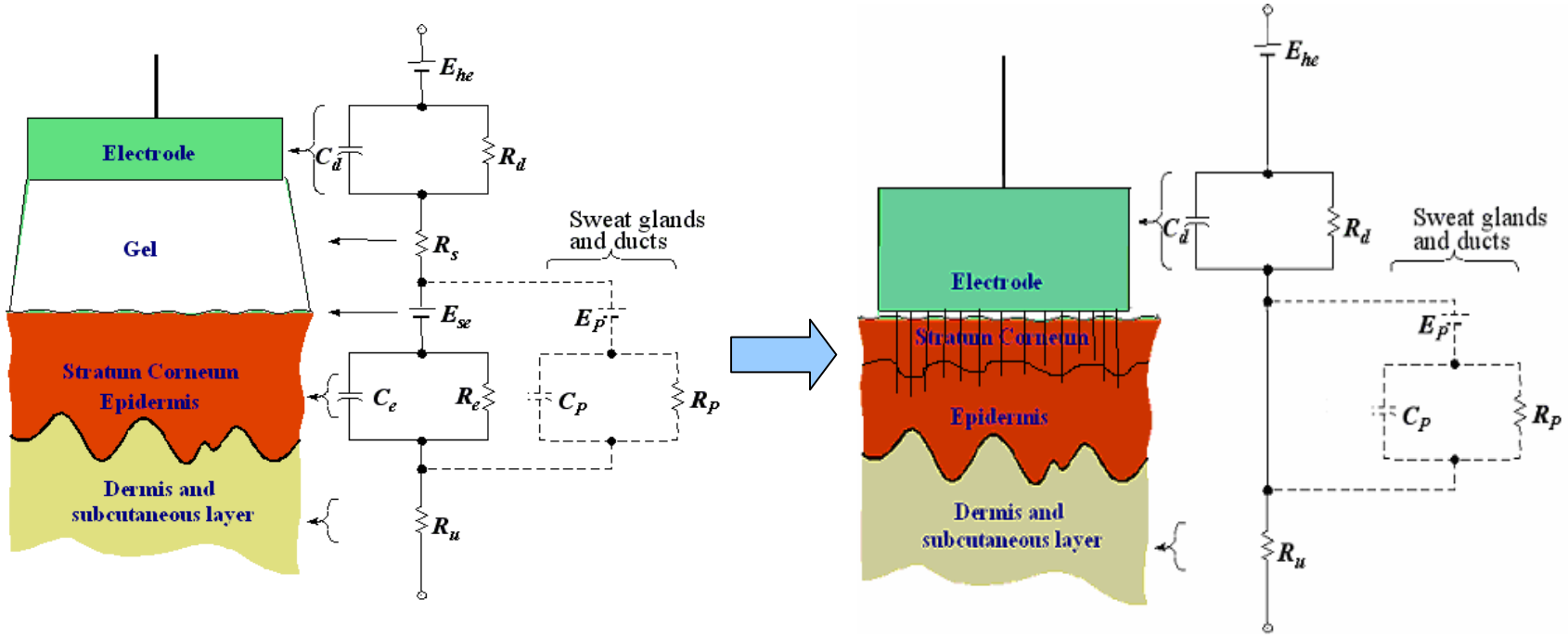
ENOBIO Concept.

- PROBLEM: Electrophysiological recordings require:
  - Electrolytic gel.
  - Skin preparation.
  - Large and complex equipment.
- SOLUTION:
  - Dry electrodes.
  - Wireless & wearable recording system.

Dry electrodes using CNTs

- Our solution was to implement dry active electrodes using arrays of Carbon Nanotubes as the electrode contact surface.
- These arrays were grown by Ravi Silvas group at the University of Surrey.

Why CNTs?

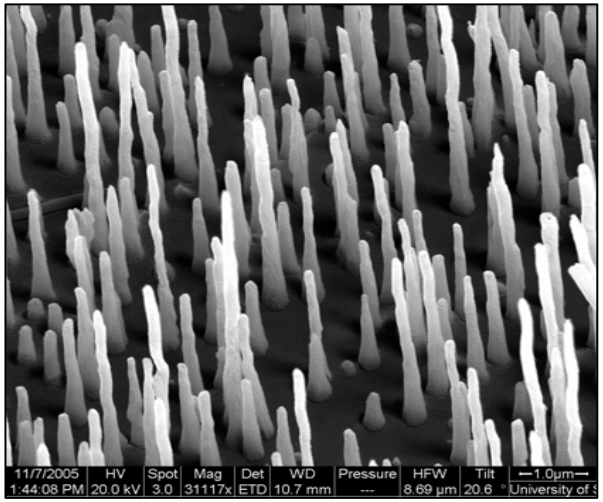


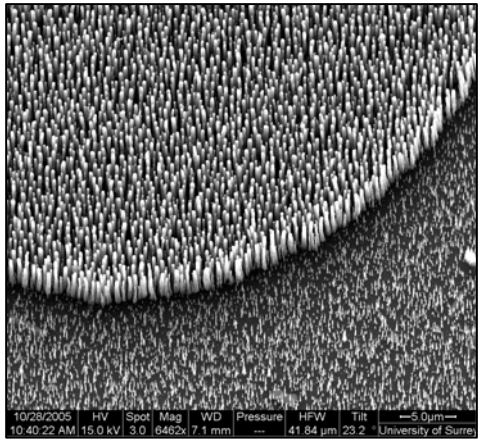
CNTs through capacitive coupling or penetration simplify the electrical model of the skin – electrode interface.

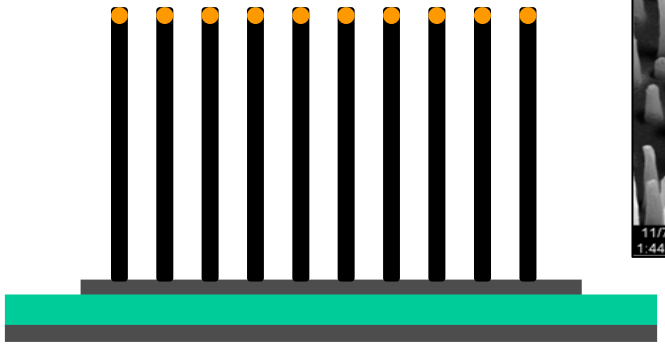
CNT growth.

Plasma Enhanced Chemical Vapour Deposition, PECVD:

C2H2/N2
5 % mix







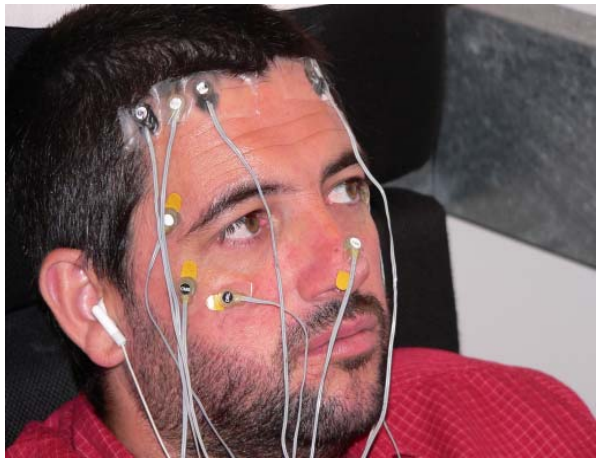
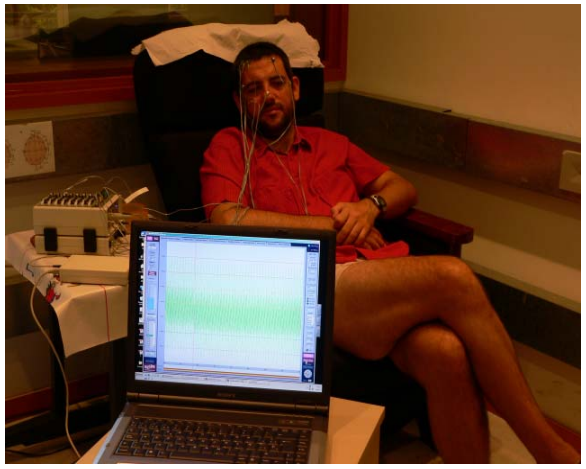
Initial tests using CNT arrays.

- Following initial testing of the arrays to ensure low impedance a short trial was approved by the various ethical bodies involved.
- The purpose of this trial was to assess the electrodes in a typical recording scenario and compare the results to that of standard wet electrodes.

ENOBIO Human Trial.

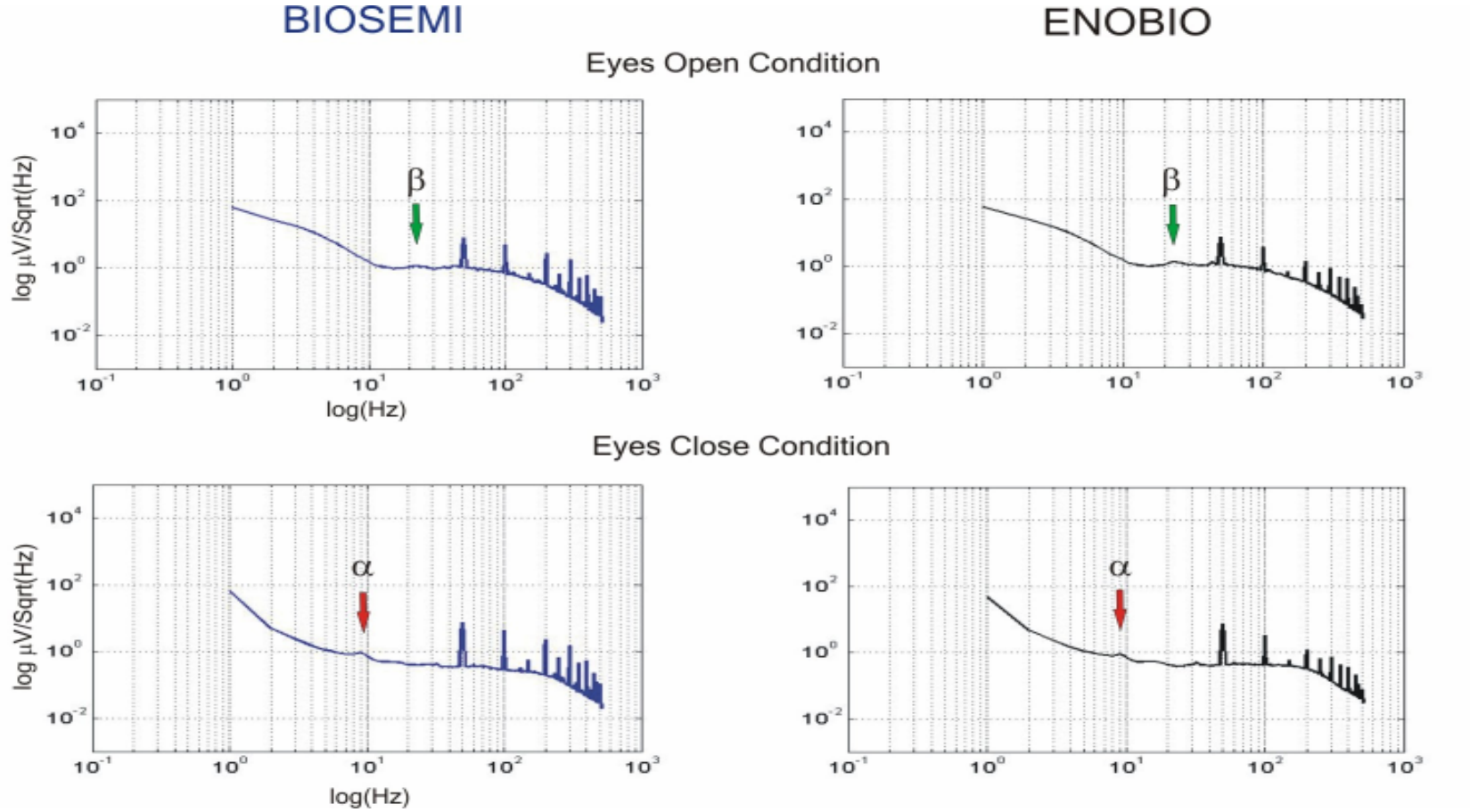
UNIVERSITAT DE BARCELONA

Experimental Protocol	
SUBJECTS	1
ELECTRODE PLACEMENT	Fp2/M1 (Left Mastoid)
SAMPLING RATE	1024Hz
FREQUENCY RANGE	0.01-300Hz
REFERENCE ELECTRODE	Nose

Starlab®

Spontaneous EEG.



Good Alpha and Beta peak detection

ENOBIO Wireless.

- In parallell we have developed a wireless system that can be used with up to 4 electrodes.
- Current concept is a wireless module with 4 active electrodes mounted on a cap.
- System has been developed using standard electrodes.
- ENOBIO CNT – Patented.
- ENOBIO Circuitry – International Patent Pending.

Results

- This is a very limited trial but these results demonstrate the potential of the CNT arrays for EEG recording.
- We are in effect benchmarking the CNT array against a standard wet electrode and have shown that they can compete.
- Further work and a significant amount of data is needed.

Why such a limited trial?

- During the early stages of the project safety concerns were raised regarding the use of CNT technology in contact with skin.
- The biocompatibility of these arrays remains an open question and the onus is on the developer to demonstrate their safety.
- Before further work can be carried out we must carry out skin toxicity studies to ensure that they are safe to use.

Starlab®

Thank you for your attention