Bio-electronic Cell Based Implant for Multiple Sclerosis Protein Therapy

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Optogenerapy Project

Optogenerapy proposes a new optogenetics implant for controlled beta interferon (IFN-ß) protein delivery for treating patients suffering from Multiple Sclerosis.

Optogenerapy represents an innovative and effective therapeutic delivery with an impact on slowing the disease progression and increasing the Multiple Sclerosis patients' quality of life.

The **Optogenerapy IFN-ß drug therapy** is **generated by cells confined within a chamber sealed by a porous membrane for safe drug release**, avoiding the adverse effects of current cellular therapies and preventing immune rejection. Wireless powered optogenetics – light controlling the cellular response of genetically engineered cells – is used to control the production of IFN-ß. Replacing standard intravenous IFN-ß delivery by subcutaneous delivery prevents short and long term side effects and efficiency-losses related to drug peaks and discontinuation, while saving non-adherence costs.

Optogenerapy's solution combines:

- **Optoelectronics** miniaturization, autonomy and optical performance.
- **Micro moulding** enabling embedding optoelectronics and other components.
- **Polymeric biomaterials** with strong optical, biocompatibility and barrier requirements.
- **Cellular engineering** design for stability and performance of the synthetic optogenetic gene pathway over long-term implantation.

Multiple Sclerosis in figures

700.000
people have MS in Europe

€2.3 bn
MS therapies' market revenue in Europe

2/3
of the people affected are women

Concept

- Drug delivery **cell chamber:** composed of a frame of biocompatible optical polymer with the surfaces closed by flat membranes
- **Optoelectronics module:** a micro-power energy harvesting antenna and rectifying circuit controlling a NIR-LED, packaged in long term hermetic and stable material

Benefits

- A reliable **ON/OFF** switch to start and interrupt the drug delivery
- Cell-produced IFN-β **not causing immune reaction** in the long-term
- Minimally invasive device
- Save the costs of non-adherence to the healthcare system: direct and indirect: **2% reduction** of total MS EU expenditure

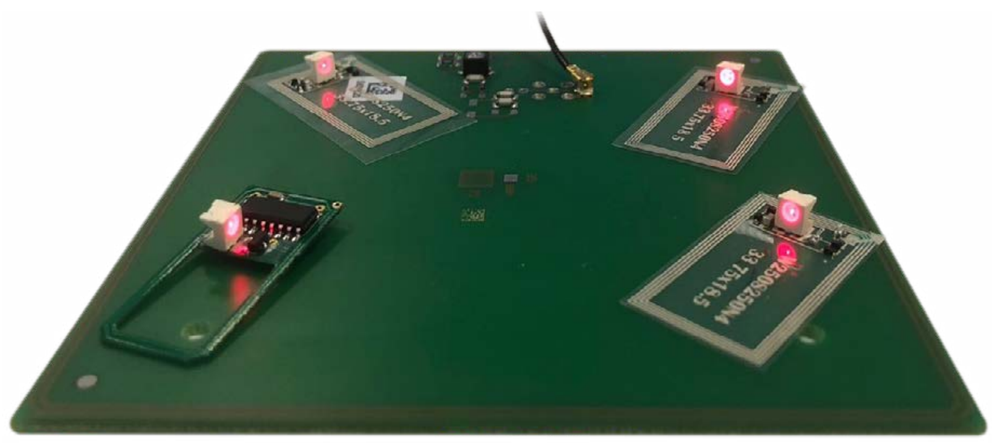
Wireless Powered Cell-Based Implant
Michel F. and Folcher M., Porto Biomed. J., 2: 145, 2017.

Functional Flexible Optoelectronics Module

Optoelectronic module components Antennas for NFC Applications

Eurecat is in charge of designing the **optoelectronic module of the implant** which consists on two components:

- **Electromagnetic antenna:** the external controller device to activate the electronics encapsulated in the implant by electromagnetic energy. It is related to the matching circuit and acts as the secondary coil to collect the generated signal by emitter plate
- **Optoelectronic unit:** electronic circuit of the implant in flexible electronics, which controls the generation of the IFN-ß drug



Compact Low-resistance Screen-printed Flexible Antennas for NFC Applications Antennas for NFC Applications

To develop the electronics, Optogenerapy partners developed flexible **compact low-resistance screen-printed Near Field Communication (NFC) antennas of high quality factor**, as well as the footprint and interconnections, on which the components are hybridized. The use of NFC technology enables the exchange of data between two devices and allows smaller Q factor antennas than the ones made by Printed Circuit Board (PCB) technologies. The flexibility and miniaturization of the tag antenna play an important role in implants, packaging, and payment applications.

Consortium

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