DESCRIPTION FOR THE GENERAL PUBLIC

Tissue engineering is a multidisciplinary field involving the development of bioartificial implants with the purpose of repairing tissue. These implants generally consist of biomaterials. Several types of **biomaterials** for tissue engineering applications have been successfully recreated in the lab but they are a long way from being fully reproducible and ready to implant into a patient. These materials have already been useful in research, especially in the development of drug delivery systems, but they are not biomimetic enough to be applied. Currently, tissue engineering plays a relatively small role in patient treatment.

Effective applications require an understanding of the biological tissue activities before and after implantation. In order to fulfill the purpose of repairing, replacing and maintaining the function of the treated tissue a few issues need to be addressed. These include several biomaterial development aspects, especially the possibility to **change the implanted biomaterials properties over time** according to the patient tissues needs. Human tissues or organs in the body have complicated functions and are not easy to replace with conventional artificial biomaterials. We should design and develop materials with better performance than before, considering the **intrinsic mutability of the human body** and that the **tissues are extremely dynamic during medical treatments**.

Stimuli-responsive materials with intelligence and drive are also dynamic. Smart biomaterials are biocompatible materials that respond to different types of stimuli, such as the concentration of certain chemicals, pH changes, temperature changes, magnetic fields, light, and electric field stimulations. The development of new synthetic chemistry strategies that lead to precise control of chemical properties has contributed to the development of smart materials, but it has not been enough to produce the required materials. The application of **nanotechnology** is an essential point in designing actual materials with higher functions because it helps in the improvement of the performance of the already existing smart materials. To develop more sophisticated drug release systems and to substitute biological functions, **the use of smart materials is inevitable**.

Hydrogels represent an important class of biomaterials in medicine because many hydrogels exhibit excellent biocompatibility, causing minimal inflammatory responses and tissue damage. Hydrogel materials have been investigated for advanced biomedical applications.

Liquid crystal applications permeated almost all segments of society, indeed liquid crystal-based devices such as watches, calculators, mobile phones and display monitors have been widely used in the past decade. Now they are coming into view also in the medical field in a variety of ways thanks to their stimuli-sensitivity. The biomedical applications of liquid crystal are currently few, but they will surely be expanded through combination with other materials thanks to the interdisciplinary actions between the fields of chemistry, nanotechnology and biomedical engineering.

The main challenge for scientists in tissue engineering is to develop an **ideal implant** that can establish an **intimate connection** with the human body that **can also tune its properties according to the requirements of the surrounding tissue**. In order to reach this objective, the development of an innovative implantable smart biomaterial is fundamental.

The proposed smart materials will be created using an **innovative electrospinning-based method** capable of producing hydrogel nanomaterials. The hydrogel will be extremely soft, in order to reduce the damage caused by the stiffness mismatch between the implant and the biological tissue, moreover its structural, mechanical, chemical and drug release properties will be modifiable applying specific external stimuli. This unique characteristic will be guaranteed thanks to the presence of biocompatible liquid crystals in its structure. Finally, the development of materials in a nanostructured form will maximize the tunability and will guarantee the needed miniaturization that is for medical applications.

It is expected that the development of the proposed biocompatible and implantable smart materials will bring **enormous advantages** to patients and will open up great opportunities for innovative and **advanced biomedical treatments** especially in the fields of neural system and cartilage treatments. Furthermore, it is also expected that the produced materials will be used in a **broad range of other fields** including filtration, catalysis, pharmaceuticals, electronics and biotechnology.