FULSENS-GEL

INNOVATIVE FULLERENOL - HYDROGELS BASED NANOMATERIALS FOR HEALTH DIAGNOSTIC AND CARE APPLICATIONS

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The FULSENS-GEL project aimed to develop an innovative nanocomposite material, based on the combination of elastic, resistant and flexible hydrogels with functionalized Fullerenol (FL)-based nanomaterials, thus obtaining new conductive hydrogels, with tunable network structures, active surface and improved electrochemical, mechanical and optical properties. By incorporating biomolecules/bioreceptors into such conductive nanostructures, unique characteristics and diverse functionalities were obtained, which can be exploited for different very promising application areas, such as: wearable and flexible sensors; point-of-care sensors for clinical diagnosis, food quality control and environmental monitoring; flexible energy storage devices; human-machine interfaces and smart sensors, based on nanomaterials with self-regeneration or self-adhesive properties.

The innovation of the FULSENS-GEL project consisted in the design and development of a multiplex, flexible, wearable and portable patch, based on the new electroconductive material of the Fullerenol-Hydrogel type functionalized with specific bioreceptors, enzymes/aptamers for the simultaneous, sensitive and selective detection of clinically important analytes (glucose, lactate, cortisol, hydrogen peroxide, chloride ions and pH) from non-invasive biological fluids (sweat). The integration of these nanostructured (bio)materials into a wearable multisensory system coupled with miniaturized and portable opto-electrochemical detectors for real-time monitoring of parameters of clinical interest represents an important contribution in the field of functional materials, both at national and European level.

The multisensory platform was characterized and optimized for the electrochemical detection of analytes of interest, as well as for the optical detection by electrochemiluminescence of cortisol using a specific aptasensor. The determination of analytes of interest from different sweat samples (artificial and real) was achieved with high accuracy, due to the degree of miniaturization and portability of the developed system, especially the new biomaterials obtained and the combined opto-electrochemical detection method.

These multisensory, flexible and portable bioanalytical platforms can be used for a series of other important compounds from food, the environment or of clinical importance, such as drug residues, hormones, pesticides, etc., allowing the control and monitoring of quality of life.

The results achieved within FULSENS-GEL project contribute to the improvement of the quality of life and to significant progress in the field of functional materials for sensing applications, responding to several scientific and socio-economic challenges of great interest.

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