Lecture 2.

***Fiber optic sensors for healthcare applications: fundamentals, applications and frontiers***

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Sensing solutions based on optical-fibre technology exhibit numerous advantageous features, which make them ideally suited for a broad variety of applications in life sciences, medical monitoring and diagnostics. Fiber optic sensors (FOSs) are indeed characterized by small size (diameter in the order of tens to hundreds of µm), lightness, flexibility, high accuracy, intrinsic safety, compatibility with diagnostic systems, immunity to external electromagnetic fields, no voltage or current flow in the fiber, possibility of continuous monitoring, and multiplexing capabilities. These features are highly desirable for healthcare monitoring and application in the biomedical field.

Distributed and quasi-distributed sensing approach allow performing multipoint measurements with single interrogation units, and sensors can be easily embedded in medical devices. These sensors are mostly used for thermal and mechanical measurements of biomedical quantities, such as biomechanical parameters, pressure, and physiological or supraphysiological temperature reached during thermal therapies for cancer treatment. Moreover, the combination of the fiber optic technology with nanomaterials has opened the door to the design of novel sensors based on surface plasmon resonance or lossy mode resonance, which are mostly oriented to biosensing, and are studied to detect pathological cells or the presence of dangerous substances in the body and in living environments.

Thus, this lecture will present a broad spectrum of applications of FOSs to be used for healthcare applications, including: thermometry during thermal therapies in oncological field, the characterization of tissue thermal properties, the monitoring of prosthetic devices and development of 3D printed patches embedding fiber Bragg grating sensors to be used for fabrication of wearable systems for sport activities monitoring. FOS-based biosensing applications for the detection of biomolecules and environmental quantities will also be introduced and discussed.