ASSIST

Smart Valves based on Active Soft Materials

CHALLENGES IN MEDICAL TECHNOLOGY FOR HOME HEALTHCARE

The demand for home-based healthcare is propelled by an ageing world population, together with an increase in disabling chronic diseases, such as obesity and diabetes. These factors are driving the development of medical technologies that can improve the function and autonomy of home-based healthcare practices. Many of the homecare technologies used in treating the most common diseases are based on complex fluidic circuits, among which infusion pumps, multiple solenoid valves, sensors and electronics. Process automation plus the development of small-sized machines that give patients greater flexibility are expected to increase sales in the near future. The long delay in technical evolution to match market needs is linked to fluid control systems, pumps and valves that determine the performance and reliability of the whole system. The main limiting factors to real miniaturisation and energy savings relate to the traditional bulky technology used in pumps and valves.

THE PROJECT: SMART VALVES BASED ON ACTIVE SOFT MATERIALS

The ASSIST project aims to close the gap between high flow, precise control and miniaturisation at a reduced cost, thus paving the way to producing a new generation of healthcare machines based on Dolphin Fluidics smart compact valves and fluidics. The proposed technology is based on integrating strain sensing nanocomposites directly within the valve.
By bringing together industrial partners with their technological expertise and academic partners with their outstanding research and development into smart stretchable nanocomposites, we were able to develop an industrial process to produce innovative smart valves with embedded soft pressure sensors. The project's results form the basis of the next generation fluid control systems for soft and wearable healthcare devices.

THE KEY ENABLING TECHNOLOGY: SUPERSONIC CLUSTER BEAM IMPLANTATION

The backbone of this project is Supersonic Cluster Beam Implantation (SCBI) technology. SCBI was originally discovered and developed by a group of researchers at the University of Milano, and can be used to construct a variety of functional polymer/metal nanocomposites for stretchable and flexible electronics applications.
Our partner WISE is the owner of the SCBI technology and has already validated and industrially scaled it. WISE is currently exploiting the technology for the development of medical devices such as implantable electrodes for neurostimulation and neuromonitoring.
In this project, we placed pressure sensors directly within pump moving parts and valves, using SCBI as the enabling, high-throughput production and integration tool for constructing high-sensitivity strain gauges made from active soft nanocomposite materials.

HIGH FLOW, PRECISE CONTROL AND MINIATURISATION AT SUSTAINABLE COSTS

ASSIST addresses issues relating to both fluid control and system design and integration by applying a cutting-edge technological solution to develop and manufacture smart fluidic devices based on active soft polymeric nanocomposites provided with sensing ability.
Smart valves produced by one of the project's industrial partners, Dolphin Fluidics, which contain shape-memory alloys (SMAs) acting as actuators, already solve the miniaturisation, energy saving and noise issues. SCBI nanocomposite sensors with embedded sensing capabilities remove the need for external sensors, as pressure measurements are supplied during operation directly in the fluidic core of the Dolphin Fluidics valve. The infusion of fluid can be controlled accurately through a closed-loop connection between the actuating SMAs and the soft sensors, providing a novel solution in wiringless portable machines for home treatment at a competitive cost.

CAPACITY BUILDING: INDUSTRIAL RESEARCH THROUGH THE EXCHANGE OF KNOWLEDGE

Besides the very ambitious technological and industrial target, ASSIST has implemented a path for industry and academia to share knowledge and skills. This process will lead to a network of researchers who can take on the many scientific and technical challenges within the widespread use of nanocomposite materials for smart biomedical applications. The unique high-level inter-sectorial and inter-disciplinary research and training has contributed significantly towards developing the professional skills required in smart manufacturing, increasing career perspectives and employability.
This level of preparation and the full exposure to leading industries and research institutions goes far beyond what could be expected from traditional academic training in a single university.

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Call to support the knowledge transfer in advanced materials research