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Micro- and Nanosensors for Medical and Biological Measurement

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Micro- and nanosensors have evolved rapidly in the last few decades and they have expanding roles within biology and medicine, where measurement science and technology is of key importance. The targets for measurement include a huge number of simple and complex molecules, physical quantities such as pressure, force, displacement and flow, and electrical and magnetic phenomena arising from the heart, brain, muscles and nerves. Routine clinical care of patients currently benefits from the use of macro- and microscale sensors based on electrical, electrochemical, acoustic, piezoelectric and optical principles. Disposable electrodes for recording biopotentials, such as the electrocardiogram and electroencephalogram, are common, whereas invasive electrochemical and optical fibre sensors for pressure, blood gases and pH are useful in intensive care. Microscale immobilised enzyme glucose sensors are largely confined to the analysis of small blood samples, their invasive use still facing technical challenges. Sensors constructed to the nanoscale using quantum dots and carbon nanotubes are now rapidly emerging, being aimed at more complex biomolecules such as DNA. Nanoparticles in general and surface-enhanced Raman spectroscopy also play important roles in these developments. The impact of micro- and nanosensors on the fundamental understanding of major biomedical challenges and on clinical diagnosis and care are highlighted here.

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