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Nanobiodevices for Diagnostics, Therapeutics, and Future Mobility

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The increased interest in scaled-down analytical processes has led to the development of various lab-on-a-chip systems. As part of the development of nanotechnology, companies and academic researchers have been creating their own systems, such as bioreactors and microarrays, to examine small volume of biological samples. These systems integrate electrical, optical, and physical measurements with fluid handling, and provide a new class of bioanalytical functions. For example, conventional measurements (e.g. electrophoresis, immunoassay, and PCR etc.) have already been carried out more rapidly and at lower cost in the systems than with current laboratory bench-scale methods. Moreover, lithographic approaches for processing hard materials with soft material processing, biochemical patterning, and microfluidics are united in this field. These technologies produced a device with feature sizes of nanometer scale, so called "nanobiodevice". This is currently being exploited at the forefront of medical science and technology [1-4].

Nanobiodevice can be recognized as a promising tool with the capability to precisely control and manipulate single biomolecules and cells constrained in a small space about 10-15 L to 10-18 L. The large surface to volume ratio of the small space enables the construction of a multidisciplinary platform, where the device serves not only for biosensing, but also for diagnostic and therapeutic applications such as advanced cancer diagnosis and ultra-sensitive fluorescence detection for in vitro or in vivo stem cell imaging in regenerative medicine. Many different materials are being explored in this field. Particularly, semiconductor quantum dots (QDs) have studied as sensor components. Functional polymer-coated QDs are used for quick detection of biomarkers and specific sequences of DNA. Polymers are also attractive for many microfluidic uses because they are easily manufactured by embossing or moulding. They can be bonded to other surfaces and are therefore often used to form a fluid channel on another surface such as silicon and glass substrate. The flexibility and ease of operation will help enable applications in mobile instruments.

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