NanoBiodevices for Cancer Diagnosis, Cancer Therapy, and iPS Cell Based Regenerative Medicine

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Nanobiodevice is a piece of contrivance, equipment, machine, or component, which is created by the overlapping multidisciplinary activities associated with nano-/quantum-technology and biotechnology, intended for biological, medical, and clinical purposes. In this lecture, I will describe the development of nanobiodevices for biomedical applications, including single cancer cell diagnosis for cancer metastasis, circulating tumor cell (CTC) detection by microfluidic devices, nanopillar devices for ultrafast analysis of genomic DNA and microRNA, nanopore devices for single DNA and microRNA sequencing, nanowire devices for exosome analysis, single-molecular epigenetic analysis, quantum switching in vivo imaging of iPS cells and stem cells, and quantum technology-based cancer theranostics[1-10]. Immunopillar devices realized the fast and low invasive "from blood to analysis" type biomarker detection of cancer with fM detection sensitivity within 2 min. Additionally, nanopillar devices give us ultrafast separation of DNA and microRNA within 60 μs and nanopillar-nanopore integrated nanobiodevice enables us ultarafast single molecular DNA sequencing. Nanowire devices coupled with super-resolution optical microscopy are extremely useful to analyze exosomes from cancer cells and exosomal microRNA analysis. Nanowire devices are applicable to ultrafast and wide range analysis of DNA Molecules by rigid network structure of solid nanowires. Quantum dots are applied to develop quantum-biodevices for single cancer cell diagnosis, single molecular epigenetic analysis, quantum switching *in vivo* imaging for iPS cell (induced pluripotent stem cells) based regenerative medicine, and theranostic devices for cancer diagnosis/therapy. Quantum dots conjugated with transferrin are developed for brain tumor cell imaging.

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