Nano- and Quantum-Biodevices for Cancer Diagnosis, Cancer Therapy, and iPS Cell Based Regenerative Medicine

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Nano-/quantum-biodevice 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. During the past decade, nano-/quantum-biodevice has progressively begun to focus on the establishment of main four fields of biomedical applications of nanotechnology, including 1) diagnostic devices, 2) molecular imaging, 3) regenerative medicine, and 4) drug delivery systems.

In this lecture, I will describe the development of nano-/quantum-biodevices 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 [1-16].

Euglena-based “biomimetic mechanical system” enables us to develop reliable circulating tumor cell (CTC) separation and detection technique for cancer metastasis diagnosis. 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. 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 based regenerative medicine, and theranostic devices for cancer diagnosis/therapy.

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