The 159th iCeMS SEMINAR

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Nanotechnology approaches for controlling neural stem cell fate

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Venue: 2nd Floor Seminar Room (#A207)
iCeMS Main Building (#70), Kyoto University

This presentation will focus on the interface between nanomedicine and stem cell biology. Even though it is well-established that stem cell fate is regulated by interactions that occur between microenvironmental cues and intrinsic cellular programs, our understanding of the function of the microenvironment and gene expression in neural stem cells is hampered by the limitations of conventional methods and the lack of extensive knowledge of multiple regulatory signals. If complex stem cell behaviors, such as differentiation and proliferation, are to be fully investigated, both approaches from nanotechnology—the "top-down" patterning of extracellular matrix (ECM) and signal molecules (e.g. ECM compositions, nanotopography, pattern geometry, and pattern density), and the "bottom-up" synthesis of multifunctional nanoparticles and their surface modification with specific signal molecules—should be combined synergistically. To address the aforementioned challenges, our research mainly focuses on two approaches: i) the development of combinatorial arrays of microenvironmental signal molecules for the investigation of stem cell behaviors; and ii) the synthesis and utilization of multifunctional nanoparticles as drug (e.g. small molecules or siRNA) and gene delivery vehicles to manipulate the expression of key genes in stem cells.

More specifically, we have applied combinatorial signal arrays to study the temporal/spatial effect of microenvironmental cues on adhesion, growth, and differentiation of neural stem cells. Furthermore, novel multifunctional nanosystems such as magnetic coreshell nanoparticles and graphene-hybrid nanomaterials were developed and utilized to deliver genetic materials into stem cells for controlling their neural-differentiation pathways and neuronal behaviors (Figure 1.). In this presentation, a summary of the most updated results from these efforts and future directions will be discussed.

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