Research Topics

The adhered cell functions sensitively respond with the bioceramic surface properties such as wettability, nanostructures, and chemical compositions. Thus, the understanding of cellular response to the nanobioceramic surfaces is crucial for successful biomedical applications.(1) We have focused on the synthesis of innovative nanobioceramics and their interfaces (i.e., "(a) the nanobioceramic-controlled cell functions through the cell-material interfacial interactions and (b) the effective cellular uptakes by the ligand-interactions").(2)-(4)

We have researched how to clarify interfacial phenomena of the cell adhesion on the nanobioceramics using various interfacial analyses, suggesting the controllable cytocompatibility.(5) Based on the results, we clarified the enhanced interfacial biocompatibility by explaining the role of highly-ordered nanostructures. As a result, the interesting mesostrucuterd silica hybrid films with biomolecules have successfully been prepared, and the different cell adhesion processes have been demonstrated depending on the structures.(6) These approaches clarify several ambiguities of the interfacial phenomena, and help to design highly-cytocompatible nanobioceramics. In future, these surface-engineering technologies of nanobioceramics will effectively encourage and improve cell theranostics.

As for the other research topic, the preparation of photoluminescent spherical nanobioceramics (e.g., calcium phosphate, titania, silica, etc.) were also focused.(7) For example, europium(III) doped nanoporous silica (Eu:NPS) nspheres were successfully synthesized, and a folate N-hydroxysuccinimidyl ester molecule as a targeting ligand for cancer cells was immobilized on the spheres. The binding and uptake of the spheres provided an orange-color luminescence from the cells by visible-light excitation.(8) The surface-engineered luminescent biocramic spheres will be used for specific targeting and imaging abilities to cancer cells.(9),(10) The multi-coupling of the functions (e.g., targeting, imaging) as well as anticancer drug therapies in a sufficient concentration on one sphere will be achieved for tumor cell theranostics.

Keywords

Nanobio Materials; Bioceramics; Inorganic/Organic Nanohybrids; Cell theranostics; Bio-imaging; Hydroxyapatite; Mesoporous silica; QCM-D; Surface-engineering; Functional nanoparticles; Collagen; Photoluminescence

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