Worldwide R&D

Designing a Bio/Nano-Interface

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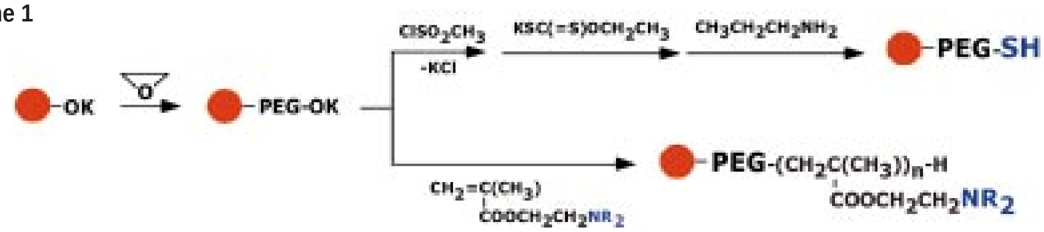
Our laboratory strives to design biomaterials that function within a living organism. The laboratory currently has twenty-five members, including Dr. Yukio Nagasaki, assistant Yoshinori Katsuyama, postdoctoral fellow Hajime Oishi, three doctoral students, ten masters students, and nine undergraduate seniors.

Scheme 1



The basic goal of our laboratory is to manufacture "biomaterials," which are materials that function within a living organism. It is particularly important to design a contact interface between blood or tissue and the material in the organism. Hence, the design of "bio/nano-interfaces" has become our most important task. In designing this interface, we have also focused our studies on polyethylene glycol (PEG), commonly found in living organisms. A hetero-bifunctional PEG having functional groups introduced in different quantities on its termini can be employed as a useful material for designing various surfaces (see Fig. 1).

By immobilizing a hetero-bifunctional PEG synthesized in this way on the surface of various materials, it is possible to design an interface on which such biological components as proteins, lipids, and cells are not adsorbed. We discovered that we could almost completely suppress nonspecific adsorption by immobilizing PEG chains with different molecular weights (Fig. 1). Highly sensitive biosensors and other devices can be created on this material surface by immobilizing specific functional groups (antibodies, enzymes, sugars, etc.) on the termini of the PEG chain.

Further, we discovered that by similarly pegylating the surface of micro- or nano-size particles, it is possible not only to control nonspecific adsorption on the surface, but also to improve dispersion stability drastically.

This revolutionary technique facilitates the use of such particles, which were previously very difficult to disperse in biological fluids with high ion concentration, such as sodium and potassium. These pegylated nanoparticles make it possible to employ various nanoparticles of gold, semiconductors, silica, and fullerene to be used in a bioenvironment.

We are now working day and night with the students to develop practical bio/nanomaterials such as these.

On October 1, 2004, our laboratory will be transferred to the Tsukuba Research Center for Interdisciplinary Materials Science (TIMS).

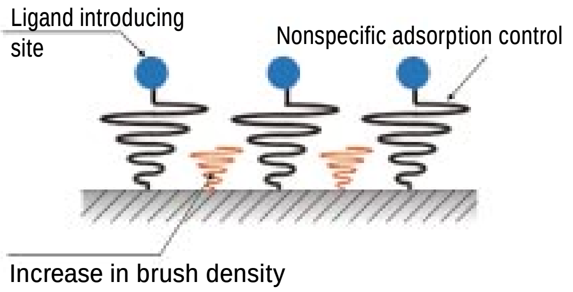


Fig. 1 Developing a highly functional bio/nano-interface

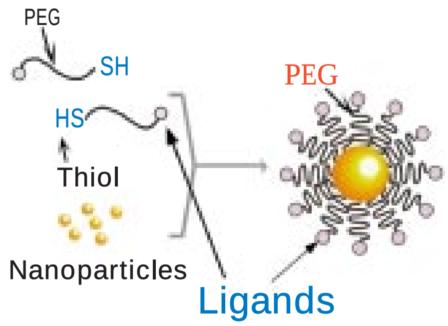


Fig. 2 Regulating pegylated nanoparticles to function in a living organism

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