Medical and bio

Nanoparticle for highly cell targeting technology

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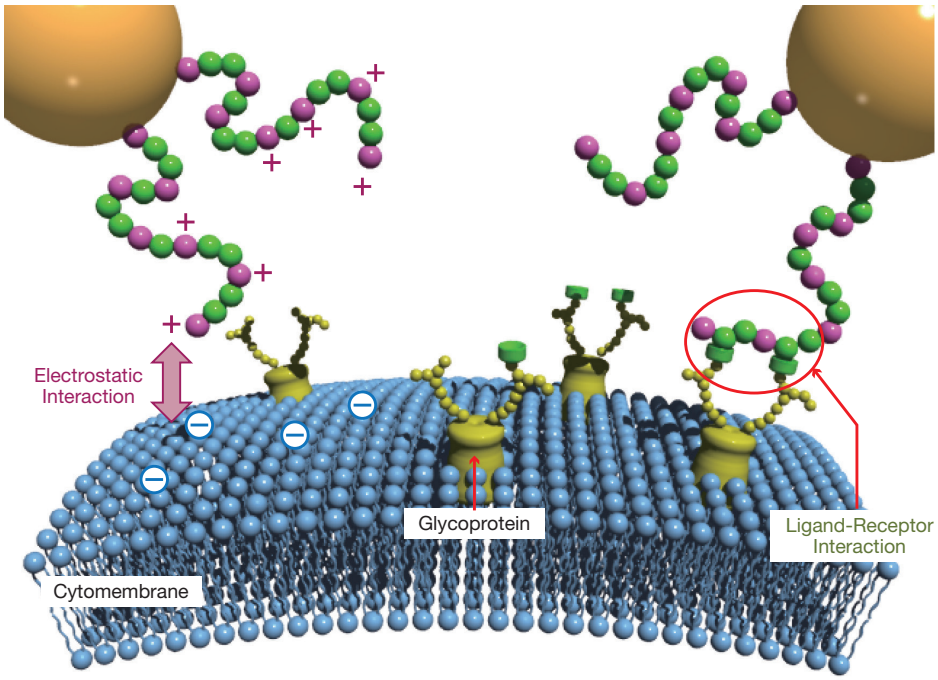
Purpose of Research

Photothermal therapy is a treatment for curing cancer using external light stimuli, which wins attentions as a minimally-invasive therapy since it does not need a surgical treatment. For efficiently achieving the hyperthermic therapy, nanoparticles need to be designed so as to have excellent in vivo biocompatibility (avoidance of capture by reticuloendothelial system (RES) around a liver or a spleen), tumor clustering and heating efficiency. In this study, we aim at implementation of more effective hyperthermia therapy through synthesizing nanorod particles having such functions. The surface of golden nanorod with high heat-exchange efficiency is subjected to surface modification which allows the surface to accumulate tumor electrostatically and receptor-specifically. Compared with the conventional technology, this novel therapy is able to promote incorporation into cell with three-orders higher specificity and to provide the safer hyperthermia therapy.

Summary of Research



All-in-one Particle in Photothermal Therapy

Electrostatic Interaction

Since the cellular surface is negatively charged due to dissociation of carboxylic group or phosphoric group, the cation unit is nonspecifically accumulated on a surface of tumor cell by the electrostatic force.

Sugar Chain-Receptor Interaction

The sugar chain is bound to the protein on the cellular surface; it is specifically bound to various receptor molecules and selectively transferred into the cell.

Photothermal Effect

It is possible to convert the absorbed optical energy to the thermal energy. The tumor cell can be cured by effective hyperthermic impact.

Points

- **Accumulation on cellular surface by electrostatic interaction of cation unit**
- **Selective coupling and cell transfer due to ligand unit**
- **Effective hyperthermia therapy**

Future Developments

- Pharmacokinetic studies are currently in progress. After the pharmacokinetic experiment is finished, in vivo pharmacology tests using model animals are expected.
- Cytomembrane-specific cellular surface of this study is confirmed to be useful for delivery of cytotoxic antitumor agent.
- We aim at undertaking collaborate projects with pharmaceutical and DDS R&D companies, and acquiring sponsored research funds.

■ Associated System:
NEDO Next Generation R&D for Function Substitution Technologies

■ Awards:
Award for Encouragement of Research in Materials Science 2011, 2010 and 2001 by MRS-Japan
Japan Biomaterial Science Encouragement Award 2005
STAM Highlights 2013 (the most popular articles 2013)

■ Intellectual Property:
Japanese Patent Application No. 2014-045240 “Molecular Carrier for Intracellular Delivery”

■ Prototype: Present ■ Sample: Available