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Protein nanoparticles: A promising carrier for cancer-targeting drug delivery

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Abstract

Certain proteins are self-assembled to form nano-scale protein particles (protein nanoparticles/PNPs) inside cells, and each PNP has a unique 3D structure (size, shape, symmetry pattern, and surface topology). For example, 24 heavy chain isomers of human ferritin are self-assembled to form a hollow sphere (~ 12 nm) by 4-3-2 symmetry pattern even in Escherichia coli. A notable advantage of PNPs is that multi-copies of functional proteins/peptides (e.g. therapeutic peptides, probes to capture disease markers, cancer cell receptor-binding ligands, fluorescent proteins, recombinant peptides for chemical conjugation of synthetic drugs or metal ions, etc.) can be genetically loaded on the PNPs with preserving their native activity and structure, which allows PNPs to be used as efficient carrier for therapeutic drugs and/ or imaging agents. In particular, the surface presentation of human albumin-binding peptides enables PNPs to be used as non-immunogenic and cancer-targeting drug carriers, and the superparamagnetic clusters of gold nanoparticles formed on the PNPs with cancer-targeting activity show an excellent performance in cancer theragnosis (i.e. magnetic hyperthermia-based therapy and MRI-based diagnosis of cancer). Since PNPs are spontaneously disassembled after loaded drugs are finally delivered to and activated inside cancer cells, and accordingly do not cause toxicity problems by in vivo long-term accumulation. The non-specific accumulation in various organs/tissues/cells is a typical problem of synthetic metal nanoparticles, which has been hampering their clinical translation although they hold a high potential as therapeutic or imaging agents. Here I introduce novel approaches that hold a promising potential for opening up a new route for developing a variety of PNP-based drug carriers.

Biography

Jeewon Lee has completed his PhD from Illinois Institute of Technology, USA in 1992. He is the director/professor of Korea University, Seoul, South Korea. As a corresponding author, he published many papers concerning synthesis and application of PNPs, including Nat. Catal. (2019), Nat. Nanotechnol. (2009), Adv. Mater. (2012, 2014, 2017), Adv. Sci. (2017, 2018), Adv. Funct. Mater. (2010a,b, 2015), ACS Nano (2013), Small (2016), Biomaterials (2012, 2014), Nanoscale (2014, 2017), etc.

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