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The novel gene delivery systems based on PAMAM derivative as carrier and their transfection mechanism

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Gene transfer vector is one of the key technologies of gene therapy. Gene carriers generally can be divided into two major categories of virus and non-virus. In non-virus carriers, polycation gene carrier due to the high rate of transfection Polyamidoamine (PAMAM) is one of the important members in the family of cationic polymer carrier. PAMAM dendrimers attracted high attention recently due to their special properties in the drug and gene delivery systems, especially the high generation PAMAM as the gene vector shows strength transfection ability compared with the other non-viral carrier materials. The main drawback for the materials is serious cell toxicity. In order to overcome this problem, one new gene delivery system has been designed by our research group. In this PAMAMs are covalently conjugated onto α-cyclodextrin (α-CD) via amide bonds to obtain the starburst-like cationic polymers (CD-PG2). The chemical structure and composition of CD-PG2 was characterized by H-NMR. The physicochemical and biological properties of CD-PG2/pDNA polyplex were evaluated by agarose gel retardation, stability test against DNase, MTT assay, DLS measurement, CLSM observation, LDH leakage test, and *in vitro* cell transfection. The test results tell us that the CD-PG2 could efficiently condense pDNA into nano-scale particles with a narrow size distribution, and protest from DNase degradation. CD-PG2 shows excellent gene transfection efficiency without serum interference as well as relatively low cytotoxicity, compared with free PET-25K and commercial product Lipofectamine 2000. The cell uptake route analysis shows cellular uptake CD-PG2/pDNA polyplex is mainly through Clathrin-mediated endocytosis, CME and Caveolae-mediated endocytosis, CvME route and further investigations demonstrate that α-CD could regulate CvME pathway to improve polyplex transfection behavior.

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Novel approaches of biomedical application of gold nanostars

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Nowadays gold nanoparticles are utilized in high technology applications such as organic photovoltaics, sensory probes, therapeutic agents, drug delivery in biological and medical applications, electronic conductors and catalysis due to their unique properties. Among the various types of gold nanoparticles gold nanostars (GNSs) feature two or more localized surface plasmon resonanses (LSPR) that undergo thermal relaxation when irradiated. Moreover, at least one LSPR falls in the near-IR (NIR) range where tissues and blood are semi-transparent making them attractive prospects for medicine and biology. The research groups at the Department of Chemistry (University of Pavia) and Department of Physic (University of Milano-Bicocca) has developed their own research field devoted to preparation, functionalization and further application of these types of gold nanoparticles. Various techniques of GNSs functionalization combining with their optical properties provide promising and prospective approaches of application in variety of biomedical fields. Nanosensing assays, thermal treatments, delivery systems based on GNS are discussed. In addition, novel approaches in inkjet printing of GNSs for thermal treatment combined with smart drug release are considered as effective solutions of important topics in medicine.

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