Glyconanosomes: Disk-Shaped Nanomaterials for the Water Solubilization and Delivery of Hydrophobic Molecules

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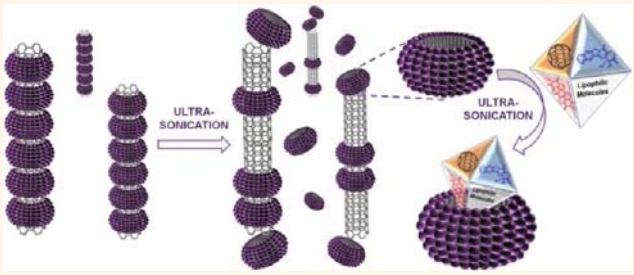
ABSTRACT Herein, we describe the first report on a new class of disk-shaped and quite monodisperse water-soluble nanomaterials that we named glyconanosomes (GNS). GNSs were obtained by sliding out the cylindrical structures formed upon self-organization and photopolymerization of glycolipid 1 on single-walled carbon nanotube (SWCNT) sidewalls. GNSs present a sheltered hydrophobic inner cavity formed by the carbonated tails, surrounded by PEG and lactose moieties. The amphiphilic character of GNSs allows the water solubility of insoluble hydrophobic cargos such as a perylene-bisimide derivative, [60]fullerene, or the anti-carcinogenic drug camptothecin (CPT). GNS/C_{60} inclusion complexes are able to establish specific interactions between peanut agglutinin (PNA) lectin and the lactose moiety surrounding the complexes, while CPT solubilized by GNS shows higher cytotoxicity toward MCF7-type breast cancer cells than CPT alone. Thus, GNS represents an attractive extension of nanoparticle-based drug delivery systems.



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During the last two decades, nanoparticle (NP)-based therapeutics have been developed for the treatment of cancer, diabetes, allergies, neurodegenerative disease, infections, and inflammations, with heavy emphasis on imaging and drug delivery.[1,2] A number of materials including polymers, dendrimers, liposomes, quantum dots, iron oxides, gold nanoparticles, and carbon nanotubes have been employed as drug carriers.[3−5] Despite the great advances achieved by this first generation of nanomaterials, the search for new tailor-made nanometric carriers with novel topologies, well-defined sizes, and improved physical and biological properties is of prime importance.[6] The general strategy used for the synthesis of NP therapeutics is based on the conjugation of conveniently functionalized payloads such as targeting agents and antitumoral drugs usually obtained through multistep chemical synthesis onto the nanoparticle surface.[7] Whereas the synthetic difficulties lie on the convenient functionalization of appropriate payloads, the design of the resulting NP therapeutics typically includes a poly(ethylene glycol) (PEG) fragment,[8] in order to reduce the rapid uptake and clearance *in vivo* by the cell mononuclear phagocytic system and an affinity ligand which permits a specific cell targeting.[9] Additionally, the overall design must contemplate the mechanism for release of the therapeutic cargo that does not denature it once the nanomedicine has reached its target tissue.[10] In some cases, the functionalization of the active principle is not possible or induces a loss of the biological activity,[11] making necessary an alternative design for the synthesis of a nanoparticle with multifunctional moieties.[6,12] Such nanoparticles contain an additional internal hydrophobic area which can host hydrophobic guest molecules such as cytotoxic

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