



Nanoparticle Drug Delivery Patents in China

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Abstract

The field of nanomedicine is attracting more investment attention recently. Especially in the area of drug delivery, nanoparticle technology plays an important role in expanding the frontiers of nanomedicine. China has made improved healthcare a domestic priority, including the introduction of more state-of-the-art medical technology. This fact and the growth potential of the Chinese economy, now the world's second largest, highlight the long-term commercial prospects in China for nanoparticle drug delivery. Gauging these prospects requires that the would-be investor or development partner gain a perspective on relevant patenting trends in China.

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How many nanoparticle-based drug delivery patents and patent applications are filed in China?

To conduct key-word searches of the patent database maintained by the State Intellectual Property Office of China (SIPO), “drug delivery” was combined with nanoparticle-related terms such as “dendrimer,” “liposome,” “micelle,” “minicell,” “fullerene,” “lattice,” “shell,” “liquid crystal,” and “gold nanorod,” respectively. These searches identified 122 patents and patent applications, listed below. This is a considerably smaller number than in the electronic and mechanical fields. Still, a relatively uncluttered patent map in China suggests that there is room for breakthrough and expansion in this area of nanoparticle-based drug delivery.

Who is seeking for patent protection in China for a nanoparticle-based drug delivery technology?

The number of foreign applicants accounts for more than 87% of the SIPO patents and patent applications revealed by the above-mentioned searches. The United States ranks number one, with U.S. applicants filing forty-two of the patent documents, followed by Germany (19) and the U.K. (10). The top three domestic applicants are China Pharma University, Fudan University, and Shenyang Pharmaceutical University, with seven filings among them.

Country	Number of Applications	Applicant	Number of Applications
China	15	China Pharma University	3
		Fudan University	2
		Shenyang Pharmaceutical University	2
		Academia Sinica	1
		Jiaotong University	1
		Xu Chuan Shan (Natural Person)	1
		Yuance Pharmaceutical Industry	1
		Beijing Jindike Institute for Bio-technology	1
		Beijing Yuan Ce Pharmaceutical	1
		Si Chuan University	1
		Industrial Technology Research Institute (Taiwan)	1
Abroad	107	U.S.A.	42
		Germany	19
		U.K.	10
		Sweden	5
		Singapore	5
		Netherlands	5
		Canada	4
		Japan	4
		Switzerland	3
		Israel	2
		France	2
		Denmark	2
		Korea	1
		Norway	1
		Italy	1
		India	1

The applicant statistic shows that the developed countries, especially the U.S., still hold an R&D advantage in this field.

Most of the overseas applicants are pharmaceutical companies, while most domestic Chinese applicants are universities and research institutes. The latter primarily are state-owned, which means in principle that they receive government funding for R&D. By contrast, the expense of developing a cutting-edge technology in nanoparticle drug delivery, including patenting expenses, exceeds the present capacity of most Chinese pharmaceutical and biotech companies.

What sorts of “nanoparticles” are involved?

As a function of the role played by different nanoparticles, inventions that appear in the SIPO patent literature can be delineated between (1) those that involve formulating a medication in particulate form, where the particles are nano-scale in size (“nanoparticulates”), and (2) those that rely on nano-scale structures, often with particular functionalities.

An example of a Category 1 invention is described in application CN 200780004479.4, entitled “Nanoparticles designed for drug delivery” (applicant: Nanodel Technologies GmbH 纳诺德尔技术股份有限公司 [Germany]). The claims of this application are directed to a mini-emulsion methodology whereby nanoparticles are produced via the addition of a defined amount of stabilizer to the reaction system. The nanoparticles thus obtained can be used in treatment paradigms that require a pharmaceutical agent to cross physiological barriers, in particular the blood-brain barrier.

Illustrative of Category 2 is the invention of CN 200480028800.9, entitled “Remedy or diagnostic for inflammatory disease containing target-directing liposome” (applicant: National Institution of Advanced Individual Science 独立行政法人产业技术综合研究所 [Japan]). The subject invention provides for targeting of nanoparticles to sites of inflammatory disease, e.g., the local delivery of a therapeutic drug or gene to affected tissues.

Where for the future?

It remains to be seen whether investors will eventually place Chinese companies in a position to displace academic entities as the predominant domestic players in developing and patenting nanoparticle drug delivery. There is uncertainty as well over whether China’s universities and research institutes can become reliable licensing sources for commercially viable technologies in this area.

The potential exists for the latter, evidenced by a recent article in the journal, *Advanced Functional Materials*, documenting work at the University of Wuhan on an “intelligent” delivery system for anti-cancer drugs. Professor Xian-Zheng Zhang and colleagues report on a nanoscale biodegradable microcapsule, formed by Layer-by-Layer (LbL) assembly.¹ This capsule retains entrapped drug as it passes through the blood stream and normal tissue, but explosively releases the drug upon the trigger of an acidic environment around tumor tissues. However, no patent application to this technology has yet appeared in the SIPO data base.

¹ Xian-Zheng Zhan et al., *Design of an “Active Defense” System as Drug Carriers for Cancer Therapy*, 22 *ADVANCED FUNCTIONAL MATERIALS* 1704-10 (2012), available at <http://onlinelibrary.wiley.com/doi/10.1002/adfm.201102132/abstract>.