FORTIS® LIFE SCIENCES

Choosing the Right Particle for Your Nanomedicine Application



Nanoparticles play an essential role in nanomedicine, facilitating early detection, drug delivery, disease monitoring and imaging.[1] Each nanoparticle type possesses unique properties that provide distinct advantages for specific applications within nanomedicine.

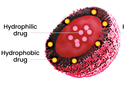
This infographic illustrates some key examples, highlighting the notable properties of lipid, polymer, and silica nanoparticles.

What are nanoparticles?

Nanoparticles are tiny particles typically ranging in size from 1 to 200 nanometers. Due to their small size, they exhibit unique physical and chemical properties that differ significantly from their bulk counterparts. These properties allow for precise control over their physical, chemical and biological characteristics, opening up new opportunities for developing novel therapies, targeted drug delivery systems and sensitive diagnostic tools.

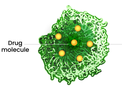
In the context of nanomedicine, three primary types of nanoparticles are commonly used to deliver a drug payload:

Lipid (liposomes and solid lipid) nanoparticles



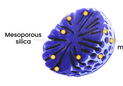
- Mimic biological membranes and encapsulate both hydrophilic and hydrophobic drugs.[2]
- Well-studied and widely accepted by agencies.
- The least customizable nanoparticle, providing limited flexibility in design.

Polymer-based nanoparticles



- Can be engineered from various natural and synthetic materials, allowing for a broad spectrum of physical and chemical properties.[2]
- High levels of flexibility ideal for therapeutic and diagnostic applications.

Mesoporous silica nanoparticles



- Excellent biocompatibility, loading capacity, and customizability.
- Provide superior stability and consistent performance, ensuring drug safety and efficacy across various applications.

Differences in nanoparticle properties and applications

Nanoparticles come in various types, each with unique properties and advantages. Selecting the right nanoparticle for a specific application is essential to maximise efficacy and safety in nanomedicine. Each type of nanoparticle – lipid, polymeric, and silica – offers distinct benefits suited to different therapeutic and diagnostic needs.

Key Properties	Lipid	Polymer	Silica
Stability	 • Moderate, prone to degradation	 • High, varies with polymer type	 • Very high
Drug loading capacity	• High *Lipids can encapsulate both hydrophobic and hydrophilic molecules*	• High *Polymer composition can be used to tune loading for co-delivery*	• Very high, especially for mesoporous silica *Can be used for small molecules or larger molecular weight payloads*
Release profile	• Prone to burst release	• Highly-tunable controlled release	• Controlled release
Biocompatibility	• Excellent	• Excellent to good, varies with material *Biocompatible and biodegradable polymers available for nanoparticle formulation, such as PLGA*	• Excellent *Natural silicon and silica content in humans lends high biocompatibility. Mesoporous structures have indicated biodegradability as well*
Size and morphology	• Limited sizes, spherical shape only	• Wide range of sizes, some shape options *Size control enables tunable circulation and release properties*	• Wide range of sizes, shapes, and porosity *Morphology control enables tunable loading, circulation, and delivery properties*
Delivery mechanism	 • Endocytosis, passive or active targeting, fusion with natural membranes *Used in vaccines, cancer therapeutics, transfection*	 • Drug depot, endocytosis, passive or active targeting *Excels at extended release timelines, such as in slow-release drug depots or nanocapsules*	 • Drug depot, endocytosis, passive or active targeting *Excellent for targeted delivery, such as in cancer therapies*
Surface customization	• Moderate, generally using charged lipids *Surface chemistry is tuned for targeting and circulation control*	• High, versatile surface modifications *Surface chemistry is tuned for circulation timelines & targeted delivery*	• Very high, customizable surface and pore chemistry *Surface and pore chemistry is tuned to enhance loading and to tune circulation timelines & targeted delivery*
Usable in composite materials	 • Lipids can be used to coat other nanoparticles *Lipid coatings can be used to increase biocompatibility and circulation time*	 • Polymer-based structures may incorporate other materials to enable properties such as conductivity or structural rigidity *Hydrogel scaffolds for wound healing, hybrid drug delivery platforms*	 • Silica is commonly used to shell other nanoparticles, or act as a core structure in composites. *Composite contrast agents for photoacoustic or other imaging & in vivo diagnostics*

Shaping the future of nanomedicine

The future of nanotechnology in medicine holds immense potential for revolutionizing how we diagnose, treat and prevent diseases. However, the effectiveness of these applications depends heavily on choosing the right type of nanoparticle. Making the right choice will enhance the precision, efficacy and safety of medical treatments, leading to better outcomes and improved quality of life for patients.



Explore the future of nanomedicine with customizable options and expert advice

References

1. Yusuf A, Almotairy ARZ, Henidi H, Alshehri OY, Aldughaim MS. Nanoparticles as Drug Delivery Systems: A Review of the Implication of Nanoparticles' Physicochemical Properties on Responses in Biological Systems. Polymers (Basel). 2023;15(7):1596. doi:10.3390/polym15071596

2. Tenchov R, Bird R, Curtze AE, Zhou Q. Lipid Nanoparticles─From Liposomes to mRNA Vaccine Delivery, a Landscape of Research Diversity and Advancement. ACS Nano. 2021;15(11):16982-17015. doi:10.1021/acsnano.1c04996

3. Zielińska A, Carreiró F, Oliveira AM, et al. Polymeric Nanoparticles: Production, Characterization, Toxicology and Ecotoxicology. Molecules. 2020;25(16):3731. doi:10.3390/molecules25163731

nanoComposix
A FORTIS LIFE SCIENCES COMPANY

Copyright © 2024. Fortis Life Sciences. All rights reserved. All content described by Fortis is the copyright of Fortis Life Sciences unless specified otherwise. You may not copy, reproduce, modify, republish, transmit, or distribute any content or images without express written permission. For Research Use Only. Not for Commercial Use. Unless otherwise stated in the product(s) specifications, any antibody product is sold for internal research use only and may not be used for any other purpose, including but not limited to commercial, diagnostic, or therapeutic use.

Distributed by Abacus dx

1800 ABACUS (AUS) 0800 222 170 (NZ) | info@abacusdx.com | www.abacusdx.com

abacus dx