Role of nanoparticle stiffness in regulating nano-bio interactions

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Mechanical properties play critical roles in many biological processes. For instance, normal human red blood cells (RBCs), which are flexible and deformable, can circulate in vasculatures for 120 days, while aging RBCs become less deformable and thus are prone to elimination by the spleen. Also, the human immunodeficiency virus (HIV) was reported to regulate its stiffness at different life cycle stages. Immature HIV particles are relatively more rigid for budding out of a host, while mature HIV particles become deformable to facilitate their entry into the host cell. Similarly, the physicochemical properties of synthetic NPs (such as size and surface properties) play critical roles in their biological functions. Recently, it has emerged that the mechanical property of NPs (stiffness or elasticity) affect biological functions. However, the effect of this parameter on nano-bio interactions and the underlying mechanism are still not well understood[1]. My lab created a library of nanocapsules (NCs) with a wide range of stiffness (kPa to GPa) that enable isolation of the effects of NP stiffness across four orders of magnitude from other properties, resulting in an unprecedented level of understanding of this vital parameter[2,3]. Our studies demonstrated the critical role of nanoparticle stiffness in regulating the formation of protein corona, immune evasion, receptor mediated nanoparticle-cell interactions and targeted drug delivery[4]. These new insights have significant implications in designing new nanoparticles for enhanced drug delivery.

References

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3. Science Advances, 6 (16) eaaz4316
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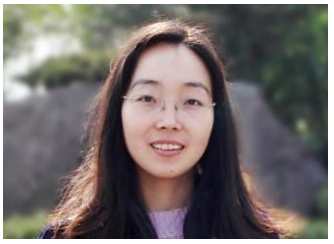

Professor Chun-Xia Zhao is an NHMRC Leadership Fellow (2022-2026) and a Professor in the School of Chemical Engineering and Advanced Materials at University of Adelaide (UofA), and an Honorary Professor at the Australian Institute for Bioengineering and Nanotechnology (AIBN), The University of Queensland (UQ). She leads a research group focusing on bioinspired engineering, biomimetic nanomaterials and microfluidics for drug delivery and controlled release.

Prof. Zhao's research in bio-inspired nanotechnology and microfluidics has attracted more than $10 M research funding since 2011 (one NHMRC, six Australian Research Council projects as the lead CI or sole CI), and the Node leader and Program Leader of ARC Centre of Excellence ($35 M), three national prestigious fellowship (2011 Australian Postdoctoral Fellow, 2014 Australian Research Council Future Fellow and 2021 NHMRC Leadership Fellow), and many UQ grants. She visited Harvard University as Fellow of the School of Engineering and Applied Science (2014). In 2016, her research excellence was recognised by the UQ Foundation Research Excellence Award. She has been appointed as member of the 2019 ARC College of Experts (2019-2021).

Prof. Zhao has published more than 100 research papers in high impact journal in international top refereed journals such as Science Advances, Nature Comm, Angewandte Chemie International Edition, ACS Nano, Chemical Communications, Advanced Healthcare Materials, Small, etc.