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Zeolitic imidazolate frameworks (ZIFs) structure and properties correlation to nucleic acid delivery

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In regenerative medicine, (intra)cellular delivery of genetic material can be used to introduce functional copies of a gene that is defective and responsible for disease development. To avoid nuclease- and lysosome-mediated degradation of the gene, drug delivery systems / carriers need to be developed. Recently, non-viral delivery systems are being developed, such as microinjection, or various chemical approaches (e.g. liposomes, polymers, lipids); due to their economical synthesis, biocompatibility and ability to transfer a variety of genetic materials and gene editing tools.1 Zeolite imidazole framework (ZIF) is a well-studied non-viral polymeric delivery system where coordination between Zn(II) and imidazolate forms a highly organised framework in aqueous solution. ZIFs offer advantageous physicochemical properties for bio-delivery applications and have been shown to encapsulate a wide range of biomolecules, including nucleic acids, via biomimetic mineralisation. Such ZIF-based delivery systems provide protection of the gene cargo and were shown to result in endocytosis-mediated cellular uptake. Further, ZIFs degrade in the acidic microenvironments of cancer cells, releasing their cargo at the target site.2,3 Both cellular uptake and release of ZIF encapsulated biomolecules are determined by the framework structure, and its crystal phase. In our work, a series of ZIF preparation methods are studied for the encapsulation of a circular plasmid. The resulting ZIF structures are characterised via FTIR, SEM, synchrotron PXRD. The aim of this project is to establish structure–property relationships to gene loading efficiency, cellular uptake and cargo release profiles.

References:
1. Sung et al. 2019, Biomater Res, 23(1), 1-7, doi: 10.1186/s40824-019-0156-z.
2. Poddar et al. 2020, Small, 15(36), 1902268, doi: 10.1002/smll.201902268.
3. Poddar et al. 2021, Chem Com, 56(98),15406-15409, doi: 10.1039/d0cc06241c.

Presenter Gender

Man

Do you wish to take part in the Student Poster Slam

No

Condition of submission

Yes

Students Only - Are you interested in AINSE student funding

Yes

Level of Expertise

Student

Pronouns

He/Him

Which facility did you use for your research

Australian Synchrotron

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