E3B The Elements of Bioremediation, Biomanufacturing & Bioenergy Metals in Biology

Durham University · University of Kent · The University of Manchester · UKRI Biotechnology and Biological Sciences Research Council

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Applying nano-flow cytometry to characterise biomanufactured magnetic fluids

"We tested the capabilities of our analytical pipeline on a nanomaterial that possesses unique properties and has a clear route to commercialization; we would not have considered this outside this collaboration" NanoFCM

PROJECT AIMS: Magnetosomes are nano-sized magnetic materials extracted from magnetotactic bacteria that have applications in cancer therapy, drug delivery and biocatalysis. To unlock the potential of magnetosomes as magnetic fluids, they need to be characterised to ensure they are consistent in structure, chain length and function. This project will determine the feasibility of using nano-flow cytometry — a rapid, cost-effective and quantitative technology — to characterise magnetosomes. The results will be compared to results produced by dynamic light scattering and transmission electron microscopy, two commonly used methods for size analysis.

OUTCOMES & NEXT STEPS:

- A research paper entitled 'Comparative evaluation of different cell disruption methods on magnetosome chain integrity from *Magnetospirillum gryphiswaldense*' is in preparation
- The PI will attend the 7th Magnetotactic Bacteria Meeting in Bayreuth, Germany in 2022
- A proposal on magnetosomes in cancer nanomedicine with Aston University and nanoFCM will be submitted to UKRI in Q3 2022
- A CASE studentship nanoFCM and Aston University will be submitted between in the 2022 call.

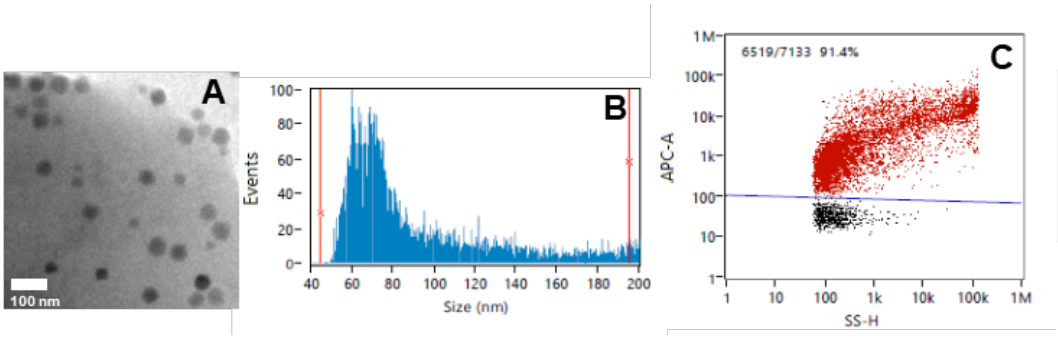
RESULTS: The project first refined methods for preparing magnetosome extracts. As a result, a revised method to prepare magnetosome extracts is now in place.

Because magnetosomes are coated by a lipid-like membrane that prevents self-aggregation, nano-flow cytometry could detect damaged magnetosomes as well as their aggregation state.

The characterisation results using nano-flow cytometry was compared with results obtained using dynamic light scattering and transmission electron microscopy. This result opens avenues for using nano-flow cytometry as a process analytical technology for magnetosome quality assurance.

Moreover, a range of dyes were tested to label magnetosomes; up to 91.4% of magnetosomes were labelled using the dyes. This additional step is ongoing using freshly prepared magnetosomes. As a result, a new method to stain magnetosomes with dyes for nano-flow cytometry analysis has been developed.

Change in technology readiness level: 1 to 3



Characterisation of short-chained magnetosomes using (A) transmission electron microscopy and nano-flow cytometry; (B) size-distribution analysis and (C) CDAR-stained magnetosomes.