Using Binary Surfactants to Improve Seedless Synthesis of Gold Nanorods for Use in Cancer Theranostics

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Our group has focussed in recent years on the development of novel nanomaterials and their surface functionalisation for use in cancer theranostics. The synthesis of metal nanoparticles with high absorption in the near-infrared and low quantum yield allows for their application *in-vivo* in photoacoustic imaging and plasmonic photothermal therapy. With recent work including the development of gold nanotubes [1] and hexagonal gold nanoplates [2] for these particular purposes.

We present here a novel seedless synthesis route for gold nanorods (AuNRs) utilising a NaOL-CTAB binary surfactant mixture allowing improved monodispersity, dimensional tunability and shape yield has been developed. The protocol was adapted from the seeded approach previously published by Ye *et al.* [3]. Through variation of the two surfactant concentrations the diameter and length of synthesised AuNRs are controllable over ranges of 10-35 nm and 40-80 nm respectively with a good level of control and reproducibility. Rod shape yields via this protocol are typically in excess of 95%, with yields of 99.99% acheivable at certain morphologies. These particles also demonstrate improved monodispersity compared to other similar CTAB-only based seedless synthesis routes.

These particles have been functionalised through the use of a PSS coating, with individual monomer units replaced with units allow binding of targetting agents to the molecule. These have been tested *in-vitro* with cultured human cancer cells for their toxicological properties and targetting efficacy with promising results. They have also been tested as contrast agents in photoacoustic imaging and as photothermal agents *in-vitro.* Future work will look to extend these models to *in-vivo* models, to demonstrate there efficacy within biological systems.

References

[1] Ye, S. *et al.*, C.B. *Adv Funct. Mater.* **25**(14) (2015) 2117.
[2] Ye, S. *et al*. *Publication forthcoming*
[3] Ye, X., Zheng, C.; Chen, J., Gao, Y. and Murray, C.B. *Nano Lett.* **13**(3) (2013) 765.

Figures

Figure 1: Synthesised AuNR solutions with longitudinal modes between 625nm (left) and 925nm (right). The longitudinal mode increases by 25nm between bottles.

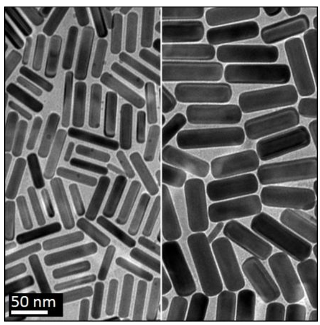

Figure 2: TEM of two batches of gold nanorods synthesized by the above protocol, of average size 12×55 nm (left) and 35×75 nm (right). The scale bar applies to both images.