Sizing plasmonic nanoparticles with Dark-Field Single Particle Spectrophotometry

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Plasmonic nanoparticles are widely used in scientific and industrial applications due to their unique optical properties. However, controlling the size and shape of large populations of nanoparticles remains a challenge, as variations in these properties can strongly influence their plasmonic response. Accurate characterisation of the morphological properties of nanoparticles is therefore crucial. In this context, a new optical method, called dark-field single-particle spectrophotometry (DF-SPS),[1] has been developed to measure individual particle sizes with nanometric accuracy in just a few minutes. The method features simple preparation, a simple experimental setup inspired by a custom optical microscope, and a measurement protocol that can be performed by untrained technicians.

A proof-of-concept study using thousands of spherical nanoparticles of different sizes showed that the method is highly accurate, with a variation of only 3% compared to the gold standard measurement technique of electron microscopy. In addition, the method has the potential to measure any geometry, including nanoshells and nanorods. Overall, the new method represents a significant advance in the synthesis and characterisation of plasmonic nanoparticles, with the potential to greatly improve the quality and consistency of nanoparticles used in various applications.

References

[1] Calvo, R.; Thon, A.; Saad, A.; Salvador-Matar, A.; Manso-Silván, M.; Ahumada, Ó.; Pini, V. Size Characterization of Plasmonic Nanoparticles with Dark-Field Single Particle Spectrophotometry. Sci Rep. 2022 Oct 24; 12 (1): 17231.

[2] Bohren, C. F. & Huffman, D. R. Absorption and Scattering of Light by Small Particles (Wiley, Hoboken, 1998)

Figures

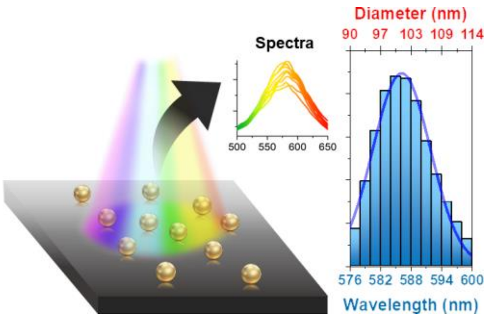

Figure 1: The DF-SPS technique involves characterizing the scattering signal of particles on a substrate, achieved by illuminating the substrate sequentially with light of different wavelengths (as depicted in the image). The resulting histogram shows the plasmonic maximum of thousands of 100 nm nominal size particles, which were converted into diameter measurements using the Mie theory.[2] The histogram data has been fitted to a Gaussian distribution, yielding an average size of 101.6 ± 2.8 nm and a CV around 6%.