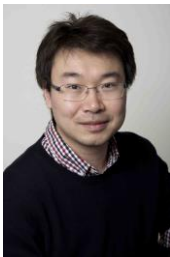

Ion-resonance nanoscale optical tweezers

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Optical tweezers are invaluable for manipulating small particles and detecting minute forces. Modern nanomaterial advancements expand their capabilities, introducing modalities like temperature and pH sensing. Yet, the challenge persists in achieving efficient 3D manipulation of nanoparticles due to their limited polarizability at the nanoscale, resulting in low trapping efficiency. Here, we present a lanthanoid ion resonance effect on nanoparticles to address the challenge and expand the force-sensing capability. By introducing the resonance effect to enhance optical trapping forces, a maximum optical trap stiffness of $0.086 \text{ pN } \mu\text{m}^{-1} \text{ mW}^{-1}$ for 23.3 nm nanoparticles has been achieved. This approach surpasses reported values for gold nanoparticles. Building on this breakthrough, the study extends the application of this novel probe to enhance precise force measurement in aqueous solutions, employing fluorescence video tracking of ion-resonance nanoparticles and pushing the boundaries of nanoscale force sensing to its thermal limit. We further demonstrated that the resonance effect can engineer the scattering properties and could be used to create dual-modality interferometric scattering microscopy.



Short Bio:

Fan Wang received his PhD degree in Photonics from the University of New South Wales in 2014 in Australia. He is a professor at Beihang University, China, leading the nanophotonic research group. He has been working in the field of photonics and biophotonics technologies, including optical tweezers, super-resolution microscopy, optical sensing and computational imaging. Prof. Wang has published over 89 peer-reviewed journal articles, including 13 Nature series articles, with 6157 citations. He was awarded a Chinese overseas young talent project, the Australia Discovery Early Career Researcher Award, the David Syme research prize and the iCANX Young Scientist Awards. His expertise is recognised through more than 20 invited talks at conferences and a Light People character interview by Light: Science & Applications.