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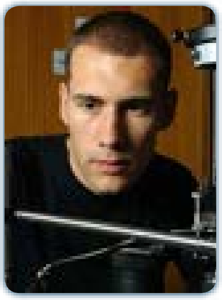

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Nanoscale optical trapping: Current challenges and future directions

Probing biological processes down to the single-molecule scale, *in vivo*, is one of the prime yet unreached goals of biomedicine. This matters because at the most fundamental level human physiology and all biological processes are the result of intricate actions of single proteins such as enzymes, motor proteins, DNA or RNA molecules. Common fluorescence microscopy techniques employ luminescent bio-labels to image biological systems. They are ensemble methods which average over the whole population of molecules and provide a coarse overview of the process under investigation. Specialized, molecule-targeted techniques do exist. They are based on optical tweezers/traps (OTs), which allow for the manipulation of small bio-labels to probe, for instance, pico-Newton forces of molecular motors such as kinesin, dynein and myosin. Whilst being a great tool, OTs are limited by the size-range of objects they can address and the forces they can exert. Classical optical trapping relies on large (~0.1-1 µm) refractive beads to work, which clashes with the push, in biomedicine, towards reaching the (sub) nanometre-scale regime of single-molecule exploration. Also, forces within living cells can be relatively large (~10 pN) and require a high-power laser in the OT; this is not ideal as it can result in cell damage. After reviewing the main limitations of current OTs, author present some of the pioneering work which they are doing to overcome these limits and develop OTs compatible with delicate biological environment and which will potentially allow for reaching size (~tens of nm) and force regimes (~hundreds of pN) unattainable with current techniques.

Biography

Carlo Bradac is a Research Fellow at the University of Technology, Sydney. He studied Physics and Engineering at the Polytechnic of Milan, Italy where he achieved his Bachelor's degree in 2004 and Master's degree in Engineering for Physics and Mathematics in 2006. He received his PhD in Physics at Macquarie University in 2012. His research focuses on colour centres in diamond and on their potential use in quantum information technologies, biomedical applications and high-resolution single-spin sensing.

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