Laser-Driven Synthesis of Nanoparticles for Therapeutic Applications

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Nanoparticles are used in a wide range of applications in medicine, technology, energy and industry. Recent interest in gold nanoparticles suspended in a solution, is due to their applications as a radiosensitiser in radiotherapy[1], and as contrast agents in MRI and CT imaging, along with many other applications in the field of medicine[2]. The most challenging aspect in production of nanoparticles is controlling the size distribution and impurities in the solution, which arise from the chemical synthesis and ball milling[3]. Recent advancements of ultra-fast lasers have enabled a new method of synthesising nanoparticles from Laser Ablation in Liquids (LAL). Femtosecond pulsed lasers can deliver sufficient energy to a target for vaporisation within the thermal timescale, allowing the generation of cold plasmas that expand adiabatically, where nanoparticle formation has been observed. As a result a pure colloidal solution possessing a narrow size distribution, and more spherical shapes compared with other methods of synthesis[4][5] can be produced. In this investigation, a gold target will be vaporised in DI water by a 550fs pulsed laser at 1.053μm. The average size and subsequently the size distribution is controlled by varying the laser fluence from 1 J/cm^2 to 100 J/cm^2. A secondary experiment involving the nanoparticle synthesis under a CW laser will be performed for comparing results, to help understand the relatively unknown physics of laser ablation and nanoparticle formation from lasers.

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