

Trap Stiffness of Plasmonic Nanoparticles Depending on the Diameter of Nanoparticles

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Optical tweezers, which trap small objects in a highly focused optical field, can manipulate objects in three-dimensional space without a physical contact. The size of objects which can be manipulated by optical tweezer ranges from a few nanometers to tens of micrometers, however the increased scattering and gravity of large objects can make it difficult to manipulate. For 3-D trapping the trap stiffness of small gold nanoparticles (AuNPs) is proportional to particle's volume, whereas for large AuNPs regime the trap stiffness still increases, but the slope is decreased compared to the small particles regime. Here, we demonstrate 2-D optical trapping on solid substrate depending on the size of AuNPs. The slope of the large AuNPs regime (> 70 nm) increases ~8 times than that of the smaller AuNPs regime, which is different from the trend of 3-D trapping. We assume that increased scattering force of larger AuNPs which are trapped on the solid substrate aids total trapping force unlike 3-D trapping. This demonstration will open new avenues toward 2-D optical manipulation such as cell sorting, biosensors, or optical printing of nanoparticles.