

Laser trapping scanning near-field imaging with an active probe

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Laser trapping scanning near-field optical microscopy (LP-SNOM) is to utilize a trapped micro-particle as the near-field probe for imaging. One of the most significant advantages is that controlling the distance between the probe and the substrate is not required in LP-SNOM. In addition, the concern associated with a fragile probe is not an issue in LP-SNOM. However, due to the low signal strength, image contrast in laser trapping SNOM requires a significant improvement. One solution to this problem is the utilization of morphology-dependent resonance (MDR) in a trapped micro-sphere. A dielectric sphere possesses natural internal modes of oscillation at characteristic frequencies corresponding to specific ratios of size to wavelength. These modes of oscillation are called MDR. MDR has been induced in micro-cavities via fluorescence excitation within a fluorescent micro-sphere [1]. Normally two beams are required in the system, one is for the trapping of the micro-sphere, and the other is for the fluorescence excitation. Under this circumstance, the focal spots of the two beams have to be dynamically controlled with high accuracy. In this paper, we have demonstrated the achievement of simultaneous trapping and two-photon induced MDR of a micro-sphere [2] by a single ultrashort-pulsed beam. The utilization of a femtosecond-pulsed beam allows for localized two-photon excitation as well as a stable optical trap for scanning. The measured dependence of the visibility of the MDR signal on the translation velocity indicates that a high sensitivity and a high scanning velocity of a trapped particle can be achieved simultaneously [3]. In addition, spectrally resolved images have been obtained, which shows that this technique can provide an alternative imaging mechanism for near-field imaging and mapping surface tomography.

References

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