The measurements of light scattering from a single PMMA particle

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This study introduced a convenient experimental method to measure the light scattering from PMMA particle. The particle levitation system was used to trap a particle and to maintain the particle at null position by utilizing electrodynamic balance. Moreover, the Raman spectroscopy was applied to observe the light scattering of a single particle.

An auto-controlled EDB was used in this study. The particles were illuminated with a 30mW solid-laser (λ=532 nm) and imaged on a monitor with a CCD camera using a zoom lens, so the particle's location upon entering the null position of the balance was monitored. The EDB was combined alternating current (AC) electric field with direct current (DC) electric fields in order to capture and levitate a single charged particle at the null position of the electric field. Because of the dry dispersion method used, the particles would ordinarily carry out one or more excess electrons through contact charging. In viewing of particles on the monitor, all but one particle were removed by charging of the alternating electric field (V_{ac}), specifically the amplitude and frequency of the central double-ring electrodes. Assuming that there was no less of particle's charge, the mass of the particle was proportional to the inputted DC voltage (V_{dc}). By employing the LabVIEW software, the position of levitated particle on the display provided system with feedback signal to adjust the V_{dc} for saving particle at null position automatically.

The Figure 1 demonstrated an experimental approach that provides insight into how particle size and refractive index affect the elastic scattering of PMMA particle. For comparison, numerical simulations based on Mie theory are also displayed. A demonstrated in Figure 1(a), 2(b), and 2(c), the intensity of scattered light polarized perpendicular to the scatter plane was strongly coupled to scattering angle and particle diameter. Besides, as illustrated in Figure 1(d), 2(e), and 2(f), the results showed the less oscillation in the forward scattering region that contributed by the parallel polarization of light. The results suggested that the larger particle contributes more oscillations and scattering intensity to the angular scattering curve (Dlugach et al., 2012; Sorensen et al., 2014). Furthermore, the refractive index influenced scattering (or extinction) in the small particle size region more than in the coarse particle size region (Bäumer et al., 2008; Kostinski and Momgkolsittisilp, 2013). Because of the surface roughness of particle, the results demonstrated that the appearance of the enhanced backward scattering with the wrinkled surface characteristic (Li et al., 2004).

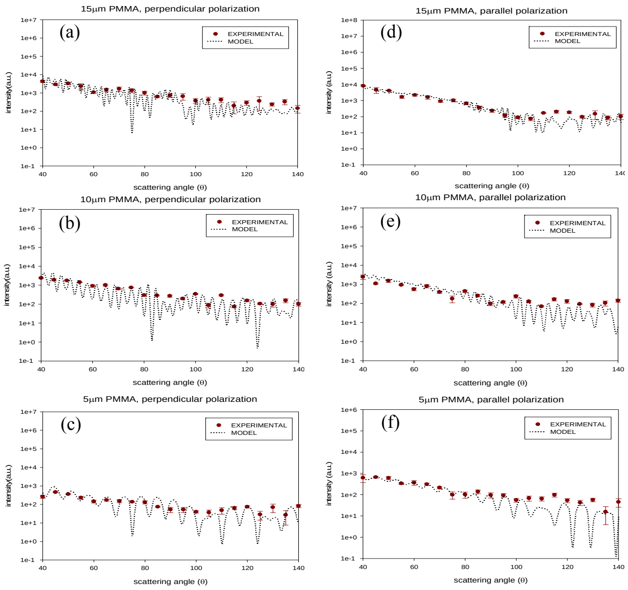

Figure 1. The scattering intensity as a function of scattering angle for PMMA particle and comparison with numerical simulation.

This automatically electrodynamic balance system might be not only conducted a steady levitation of single particle but also provided an advantage measurement of light scattering. For a light- scattering material, like PMMA, the scattering intensity of perpendicular polarization was strongly correlated to angle as well as particle diameter; furthermore, parallel polarization provided less oscillation in the forward scattering regions. In addition, the larger particle contributed more oscillations and higher intensity to the scattering curve.

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