Comparison of nanosecond and femtosecond laser ablation in a single particle mass spectrometer

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Single particle mass spectrometry is a valuable technique for the analysis of composition and mixing state of individual aerosol particles. Laser ablation is the dominant method for desorption and ionization of the particles. Due to their relatively high power, UV wavelength, and good triggering options, excimer lasers are often used to realize desorption and ionization in one single step. Several single particle mass spectrometers have been developed in the last two decades for both online and offline measurements, all showing the necessity of improved quantitative analytical ability. Recently, the first test with a single particle mass spectrometer deploying femtosecond laser pulses indicated the potential for improved quantification compared to excimer laser ablation (Zawadowicz et al., 2015).

We present new results of femtosecond laser ablation single particle analysis. In this work we used the laser ablation aerosol time-of-flight single particle mass spectrometer LAAPTOF (AeroMegt GmbH), originally equipped with a 193 nm excimer laser (Marsden et al. 2016; Gemayel et al., 2016). Since triggering of typical femtosecond-lasers is hard to realize, some technical changes were applied allowing the acquisition of mass spectra with hit rates comparable to the original set up. Mass spectra of the aerosol particles with different sizes from 400 nm to 1100 nm and core-shell particles, i.e. metal-metal and metal-organics, have observed with the both excimer and femtosecond lasers.

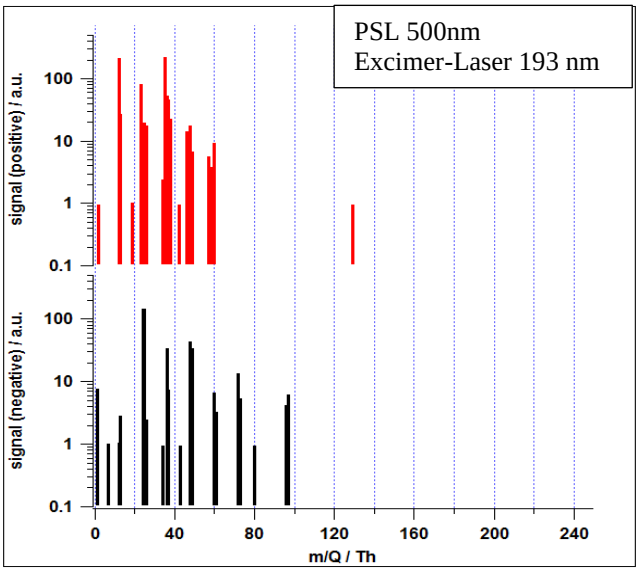

Figure 1. Mass spectra of PSL 500 nm particle with 193 nm Excimer laser

Figure 1 and 2 show the differences in two mass spectra for monodisperse 500 nm PSL particles using nanosecond laser pulses of 193 nm and femtosecond laser pulses of 800 nm. We can observe the intensity of fragments and also the numbers of C/CH fragments are different in both the spectra.

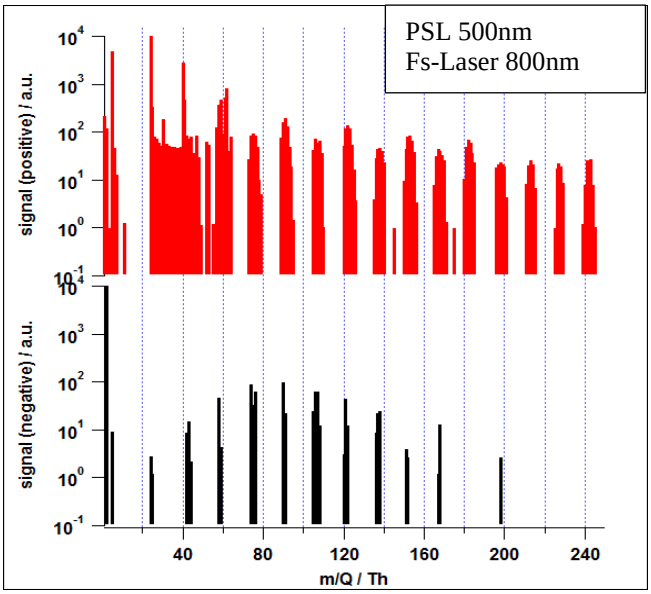

Figure 2. Mass spectra of PSL 500 nm particle with 800 nm femtosecond laser

We will discuss more differences in the mass spectra observed using femtosecond and nanosecond laser pulses of different wavelength and power for laser ablation for the aforementioned particles.

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Marsden et al. (2016) *Atmos. Meas. Tech. Discuss.*
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