

## Particle mass spectrometer (PMS)

*Particle mass spectrometer for airborne particles in flames and plasmas*

### Category:

**C. Particle Characterisation in and ex-situ**

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### Technology description

The particle mass spectrometer (PMS) is a novel online measurement system for high concentrations of charged nanoparticles in flames, plasmas and other aerosol systems. It measures size distributions in atmospheric and low pressure applications from 1 nm to 30 nm, at high particle number concentrations which goes beyond the present state of the art. Due to its compact design, the PMS is a robust and mobile instrument that can be adapted readily to various types of particle reactors in research and industry.

### Functional description

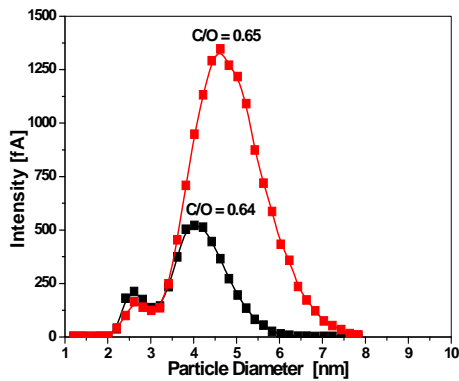
The particle mass spectrometer (PMS) has a two stage molecular beam sampling system which transfers the sampled particles rapidly into a low pressure environment around  $10^{-5}$  mbar. The particles pass a capacitor, where the charged particles are deflected from the straight path line according to the ratio of their kinetic energy to charge number ( $U \sim \frac{1}{2} mv^2/z$ ). The deflected particles are collected at faraday cups and the particle velocity is measured simultaneously with the recorded current.

The current is proportional to the particle concentration in front of the inlet. By scanning the voltage applied at the capacitor, different mass fractions reach the detector and with the knowledge of the material density, the measured mass spectrum ( $m/z$ ) can be converted into a size spectrum. If the particles carry multiple charges, two or more peaks are observed in the  $m/z$  spectrum.

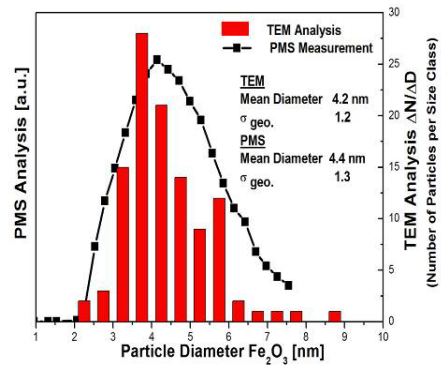
### Main Features (Equipment Capabilities):

- **Measurement range:** 1 – 30 nm
- **Measurement time**  
(for full range scan): 1 – 5 min
- **Detection limit:** 1 femtoampere [fA] or 6500 charges/s
- **Concentration:**  $> 10^9$  particles/cm<sup>3</sup>
- **Resolution:** 2 – 5 % of particle diameter

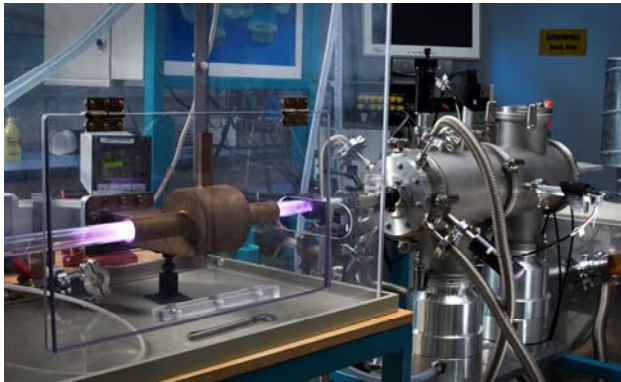
### Typical Results:



Size distribution of soot particles in an atmospheric ethylene / air flame



Size distribution of iron oxide particles generated by microwave plasma synthesis



Low pressure – PMS attached to a microwave plasma



Atmospheric - PMS attached to a McKenna burner