INSTRUMENTAL TECHNIQUE PRESENTATION

High-Field Asymmetric Waveform Ion Mobility Spectrometry (FAIMS)

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Whai is FAIMS?

FAIMS is a new technology capable of separation of gas-phase ions at atmospheric pressure (760 torr) and at room temperature. FAIMS can be operated over a wide range of pressures and has been tested above 1500 torr. FAIMS will operate at lower and higher temperatures.

Why is it called FAIMS?

In order for FAIMS to operate, several essential conditions must be met:

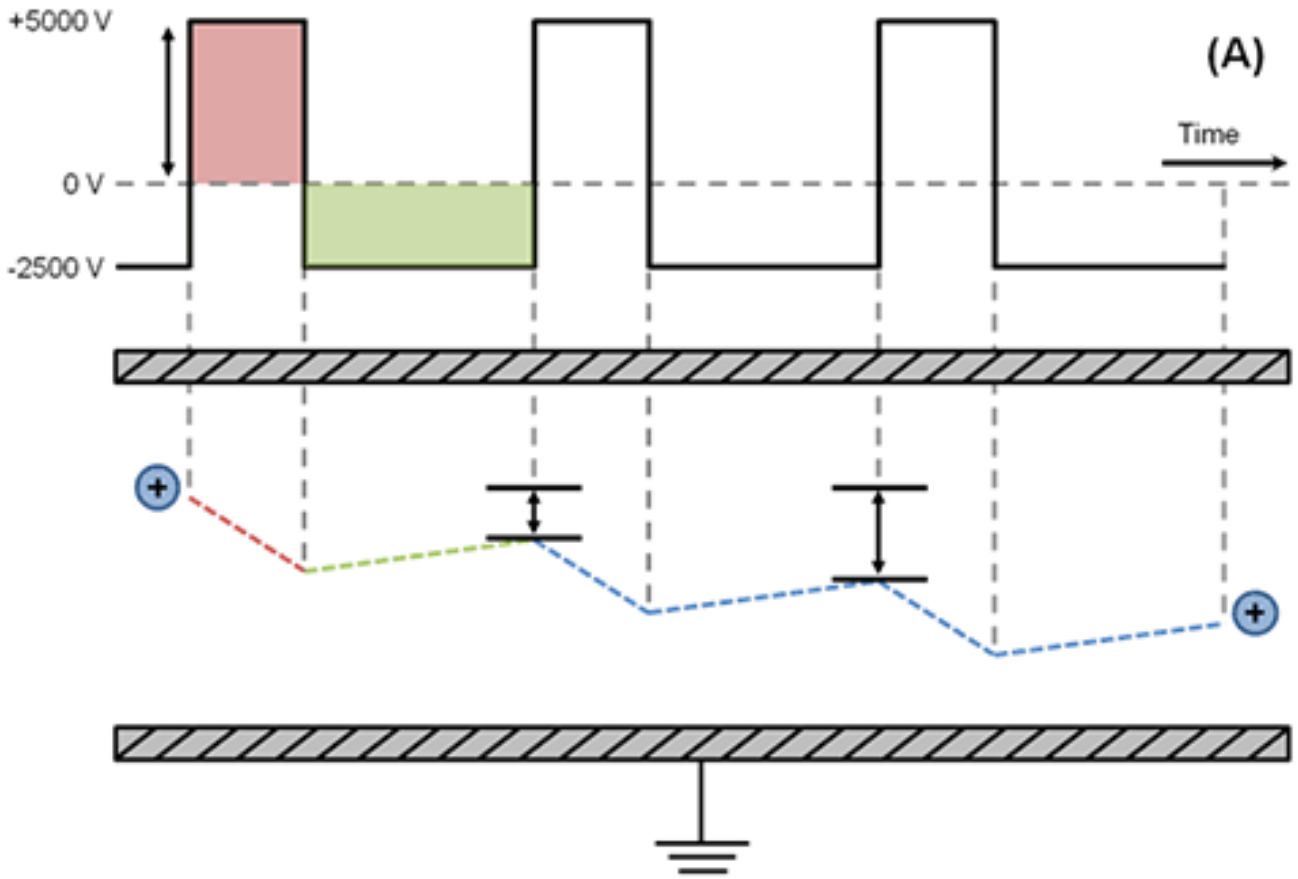
(1)Strong electric fields are required. FAIMS typically operates with fields of 10 000 volts/cm.

(2) A periodic electrical waveform is applied to conductive surfaces about 2 mm apart. The electrical waveform must be 'asymmetric', which means that there is a significant difference between the peak +ve voltage, and the peak -ve voltage during the applied waveform. Either of the +ve or the -ve may be higher voltage.

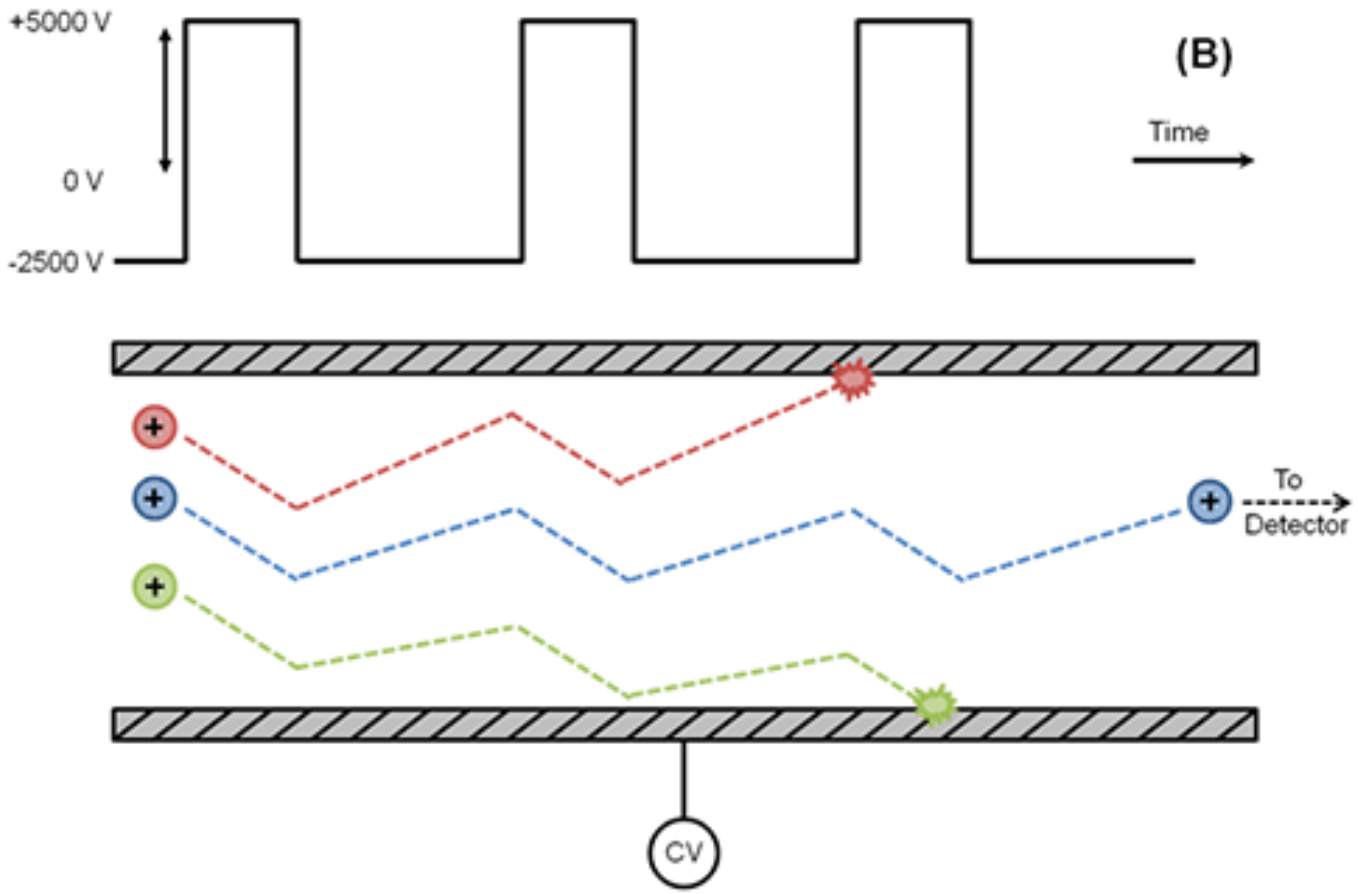
(3)The device is based on "ion mobility", which means that an electric field is used to drag the ions through a gas which is dense enough that the ions rapidly reach a terminal velocity. The terminal velocity is roughly proportional to the strength of the electric field. This proportionality changes at high electric field and makes the operation of FAIMS possible. Just as importantly, this proportionality is compound-dependent, permitting the separation of ions from each other.

How does FAIMS work?

Separation:

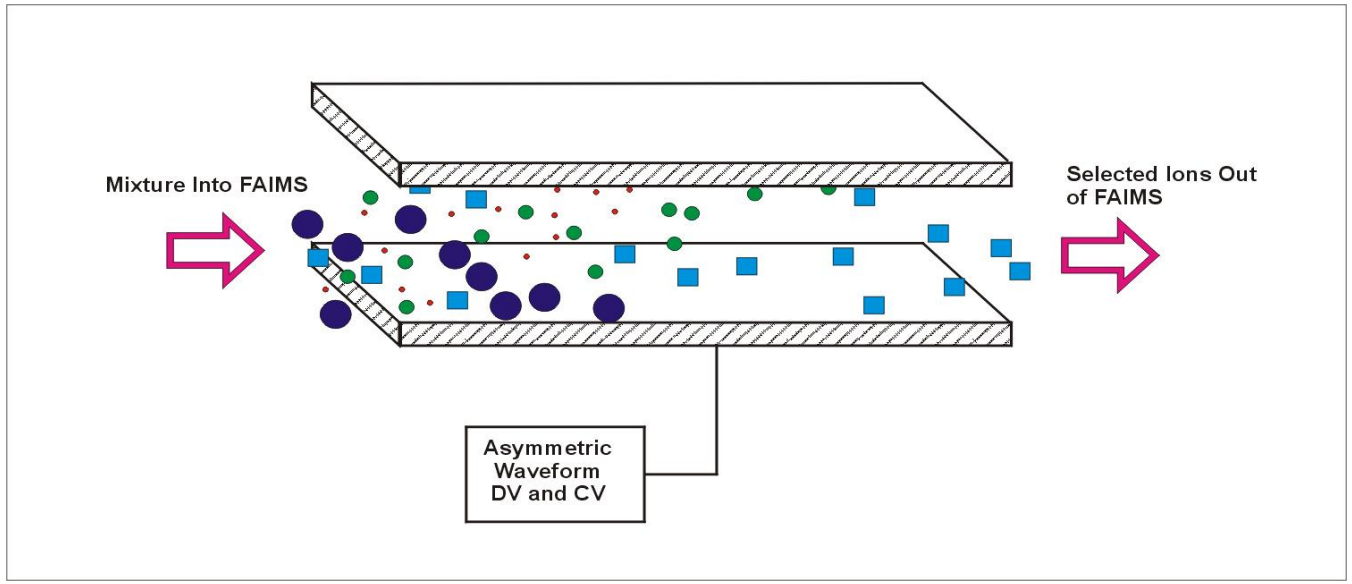


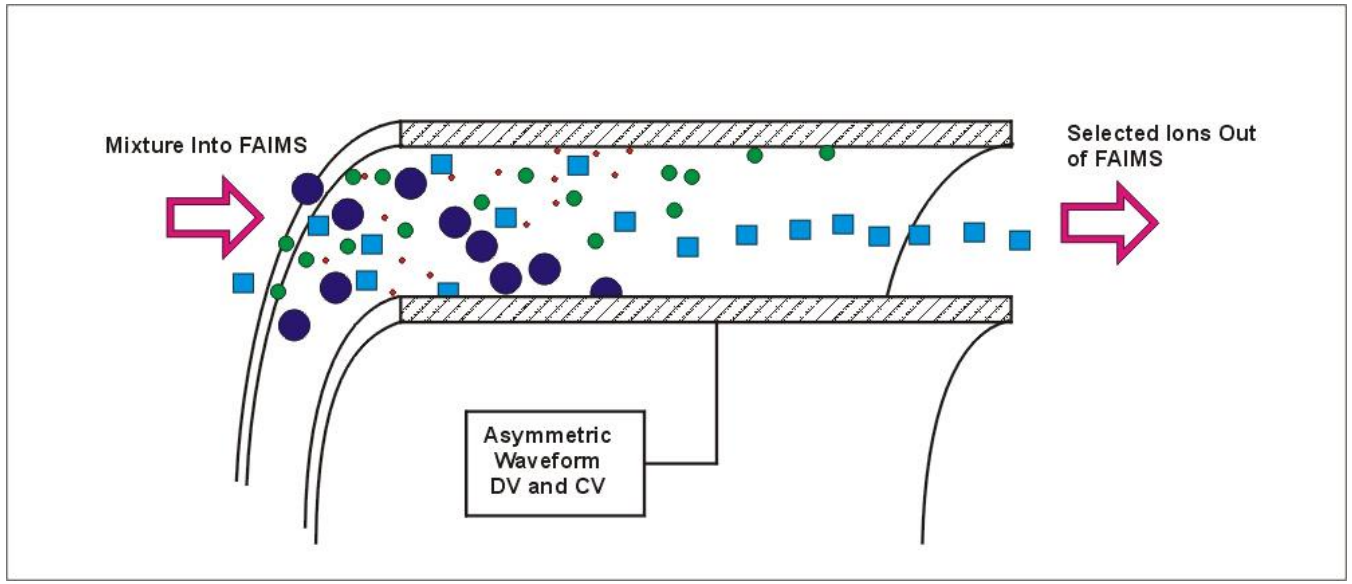
- While subjected to a high field, an ion has a greater mobility, causing it to drift faster toward the lower plate.
- When the field is switched, the ion's mobility decreases, and it drifts toward the upper plate.
- Due to the asymmetry of the waveform, there will be a net displacement of the ion after one period of the waveform as the ion will not cover the same vertical distance when in low-field as it did in high-field.
- With each continuous period, the ion will move closer and closer to one of the electrodes until it makes contact and is annihilated.



- The drift of an ion towards one of the metal plates can be stopped by the application of a small dc voltage to either of the plates.
- If the voltage is applied with the appropriate magnitude and polarity, the ion will feel the force of this field and the drift of the ion will be stopped. We call the voltage which is applied to reverse or compensate for the ion drift, the 'compensation voltage' or 'CV' for short.
- The CV is therefore the 'handle' we use to control the separation of ions.

Focusing:





- The ions exit the cylindrical plate system at fixed radial location as compared to the flat plates.
- This means the ions are focused towards a fixed radial position between the electrodes for cylindrical plates.
- If the ion is near the inner electrode, it will migrate away from the inner electrode. If the ion is near the outer electrode, it will migrate towards the center of the space between the two electrodes. Although the ions feel a force which directs them towards this focus point and are being distributed in space around this focus point due to the influences of diffusion, space charge and ion-ion repulsion, and bath gas motions.

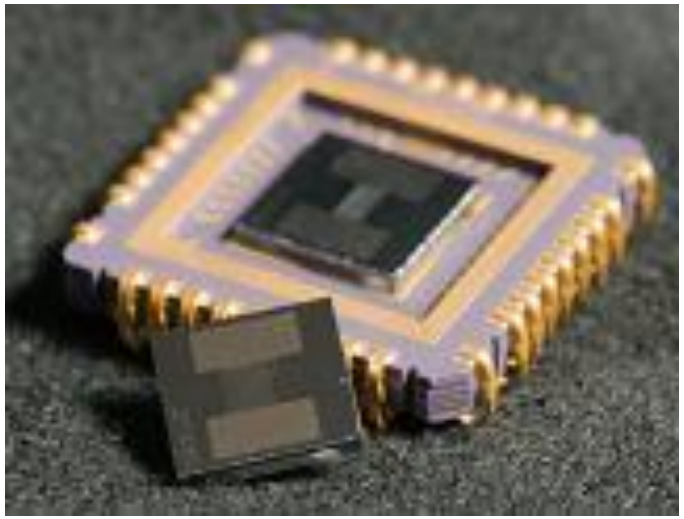
Other effects:

- Electric field strength
- Waveform shape and frequency
- Bath gas composition
- Temperature
- time

Applications:

- Separation of enantiomers
- Separation of positional isomers

Chip based Ultra FAIMS



- Owlstone and Agilent Technologies collaborate to explore FAIMS/TOF-MS applications in 2009 where the main goal was to reduce the analysis time of LC by using FAIMS.
- The results demonstrated that the Ultra-FAIMS device does deliver additional selectivity that can enhance pharmaceutical analyses by reducing or eliminating background noise and by separating co-eluding ions.
- The difference is the unique chip based design, which has enabled the analytical gap width to be reduced to 100 µm or less.

..... Thank You .....