structural isomers of the analyte molecules in the sample. Conformational isomers, on the other hand, can transform into other forms at higher temperatures. The distribution of conformational ions in the ion mobility spectrum shows how their original distribution in the sample may be modified by the processes in the ion source and, in further steps, by temperatures of the surrounding gases. Such transitions can be avoided, however, by carefully keeping the gas temperatures low. Alternatively, such transitions can be deliberately induced by temperature changes of the gases surrounding the ions in order to be investigated.

[0061] An advantage of the methods and instruments according to the present invention is the combination of high mobility resolution and the compact size of the necessary devices. A further advantage is that the necessary devices can easily be incorporated into a mass spectrometer.

[0062] Although the present invention has been illustrated and described with respect to several preferred embodiments thereof, various changes, omissions and additions to the form and detail thereof, may be made therein, without departing from the spirit and scope of the invention.

What is claimed is:

1. A method for dividing ions in a gas according to their mobility, comprising:

forming a supersonic gas jet, having gas molecules with substantially equal velocities, by directing the gas through a Laval nozzle into an evacuated chamber;

forming a field barrier, having a substantially uniform height across a cross-section of the supersonic gas jet, by respectively applying potentials U_2, U_3 and U_4 to an arrangement of three apertured diaphragms R_2, R_3 and R_4, which are respectively separated by distances d_2 and d_3, where $(U_4-U_3)/(U_3-U_2)=d_3/d_2$; and

directing the ions in the supersonic gas jet against the field barrier, where ions with a mobility less than a mobility threshold are pushed over the field barrier, and where ions with a mobility higher than the mobility threshold are held back by the field barrier.

2. The method of claim **1**, where the apertured diaphragms R**2**, R**3** and R**4** have substantially equal aperture diameters.

3. The method of claim **1**, further comprising measuring an ion current of the ions pushed over the field barrier.

4. The method of claim **3**, further comprising performing the measuring of the ion current with an ion detector without mass separation.

5. The method of claim **3**, further comprising performing the measuring of the ion current with a mass analyzer.

6. The method of claim **4**, further comprising:

providing a continuous current of the ions from an ion source;

pushing the ions with mobility less than the mobility threshold over the field barrier with the supersonic gas jet;

measuring passing ions in the form of a total ion current curve as a function of the height of the field barrier; and

generating a mobility spectrum by differentiating the total ion current curve.

7. The method of claim **5**, further comprising:

providing a continuous current of the ions from an ion source;

pushing the ions with mobility less than the mobility threshold over the field barrier with the supersonic gas jet;

measuring a series of mass spectra of passing ions as a function of the height of the field barrier;

extracting ion current curves for ions of individual mass ranges from the mass spectra; and

generating mass separated mobility spectra by differentiating the ion current curves.

8. The method of claim **7**, further comprising:

setting the height of the field barrier to measure fragment ion spectra of ions with lowest mobility; and

lowering the field barrier to measure mixtures of ions of the lowest mobility and ions of higher mobility.

9. An ion mobility spectrometer, comprising:

an ion source that generates ions in a gas in a high pressure region of the ion mobility spectrometer;

a Laval nozzle that generates a supersonic gas jet from the gas with the ions in a lower pressure region of the ion mobility spectrometer;

an arrangement of three or more apertured diaphragms R_2, R_3 and R_4 through which the supersonic gas jet moves axially, where the apertured diaphragms are respectively separated by distances d_2 and d_3;

a power supply that respectively supplies the apertured diaphragms with potentials U_2, U_3 and U_4, where $(U_4-U_3)/(U_3-U_2)=d_3/d_2$; and

an ion detector that measures a current of the ions passing the apertured diaphragms.

10. The ion mobility spectrometer of claim **9**, where the Laval nozzle is located between a region maintained at atmospheric pressure and a first vacuum chamber, or in a wall located between two vacuum chambers of a differential pumping system.

11. The ion mobility spectrometer of claim **9**, further comprising an additional RF quadrupole rod system located between the Laval nozzle and the arrangement of apertured diaphragms.

12. The ion mobility spectrometer of claim **9**, where the ion detector comprises a mass spectrometer.

13. The ion mobility spectrometer of claim **12**, where the mass spectrometer comprises a time-of-flight mass spectrometer with orthogonal ion injection.

14. An ion mobility spectrometer, comprising:

an ion source that generates ions in a gas in a high pressure region of the ion mobility spectrometer;

a Laval nozzle that generates a supersonic gas jet from the gas with the ions in a lower pressure region of the ion mobility spectrometer;

a coaxial arrangement of three or more apertured diaphragms R_2, R_3 and R_4 through which the supersonic gas jet axially moves;

a power supply that respectively supplies the apertured diaphragms with potentials U_2, U_3 and U_4 such that a field barrier is generated at the apertured diaphragm R_4 having a substantially uniform height across a cross-section of the supersonic gas jet, and such that ions in the supersonic gas jet are directed against the field barrier, where ions with a mobility less than a mobility threshold are pushed over the field barrier, and where ions with a mobility higher than the mobility threshold are held back by the field barrier; and

an ion detector that measures a current of the ions passing the apertured diaphragms.

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