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(56) Documents Cited:
CN202373552U
US2010282957A1
WO2010136779A1

(58) Field of Search:
INT CL H01J
Other: CNTXT, DWPI, USTXT, JPTXT, EPTXT

(54) Title of the Invention: **Electrode structure for ion migration tube and ion migration tube having same**
Abstract Title: **Electrode structure for ion migration tube and ion migration tube having same**

(57) An electrode structure (2) for ion migration tube and an ion migration tube which includes the electrode structure (2) are provided. The electrode structure (2) includes an annular electrode whose inner edge is bent towards one side, and the cross section of the center part of the annular electrode is a swallow-tail-shaped. When an ion migration detection instrument is used, the migrating state ions can be traveling along the focusing power line. And because the high voltage interval between the electrodes is uniformly accelerated increase, the electric field generated by the electrode structure can make the ion in a uniformly accelerated migration status, and at the same time the resolution and sensitivity of the migration spectrum can also reach the best.

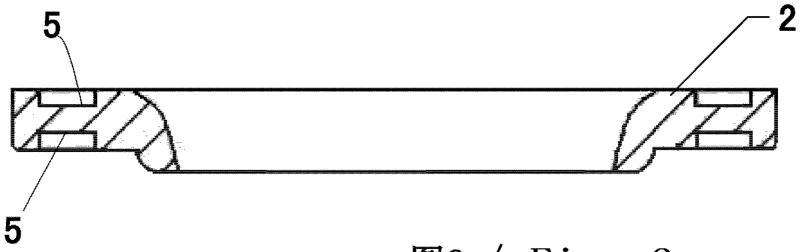

图2 / Fig. 2

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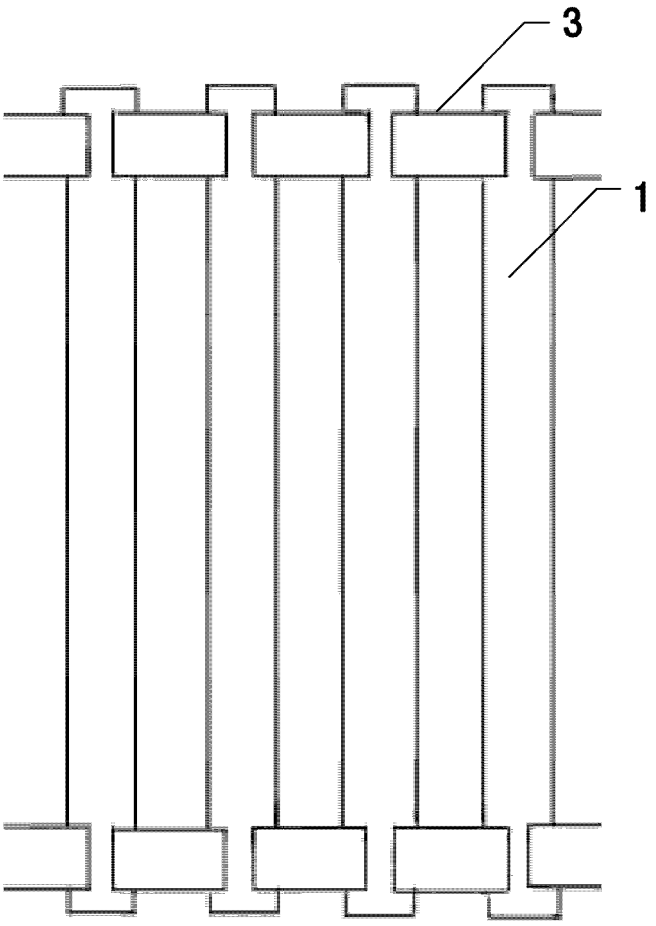

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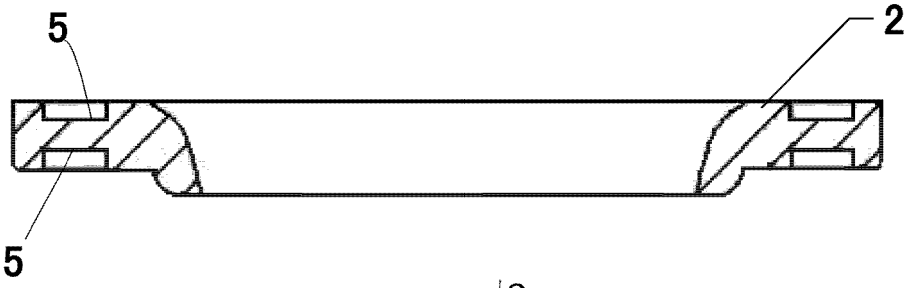

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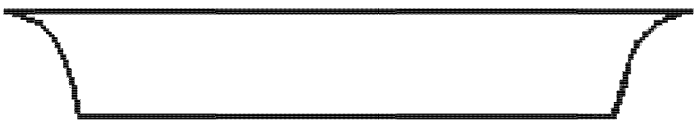

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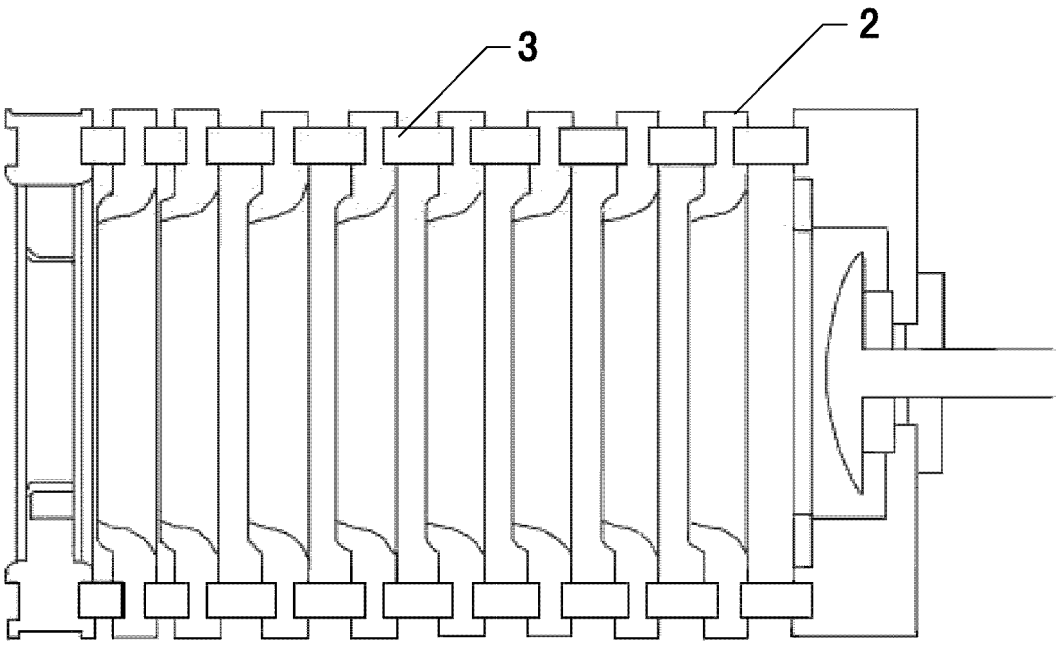

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ELECTRODE STRUCTURE FOR ION DRIFT TUBE AND ION DRIFT TUBE INCLUDING THE STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a field of ion drift technology, and in particular to an electrode structure for an ion drift tube and an ion drift tube including the same.

2. Description of the Related Art

In the field of safety inspection, detection of hazardous articles such as drugs, explosives, chemical agents and industrial toxicants is an extremely important work. Therefore, many detection instruments for the above articles have been developed. Currently, the detection instruments using the ion drift technology are most common. Two indexes that are most crucial in the ion drift technology are sensitivity and resolution of a detector. It is a main object of design and fabrication of the ion drift tube to optimize the two indexes. The ion drift tube is a core part of an ion mobility spectrometer and is used to generate a uniform electric field so that ions having different mobilities are separated. As shown in FIG. 1, in a conventional ion drift tube, drift of ions is controlled by a uniform high-voltage electric field by thin sheet electrodes 1 having the same size spaced equidistantly by means of insulating parts 3. In the ion drift tube,

the ions drift in the air under the normal pressure. The uniform electric field generated by the conventional structure shown in FIG. 1 is an approximate model and a non-ideal uniform electric field. In addition, the ions are simultaneously subjected to factors such as the high-voltage electric field and air resistance. Therefore, uniform equidistant high-voltages cannot well generate pre-acceleration, focusing, a maximal amount of drift of the ions and the like. As a result, it is difficult for sensitivity and resolution of a mobility spectrum obtained by the ion mobility spectrometer to reach optimum.

SUMMARY OF THE INVENTION

a. Technical Problem to be Solved

The technical problem to be solved by the present invention is how to provide an ion drift tube so that sensitivity and resolution of a mobility spectrum of a detection instrument with the ion drift tube reach optimum.

b. Technical Solution

In order to solve the above technical problem, the present invention provides an electrode structure for an ion drift tube comprising: an annular electrode, wherein the annular electrode has an inner edge bent towards one side such that a section of a central portion of the annular electrode has a swallowtail shape.

In accordance with an aspect of the present invention, the inner edge of the annular electrode has a substantially tapered shape.

The present invention also provides an ion drift tube comprising the above electrode structures arranged at intervals. The inner edges of the annular electrodes of the electrode structures are bent in a same direction, and the same direction is an opposite direction to an ion drift direction.

In accordance with an aspect of the present invention, the electrode structures are arranged at decreasing intervals in the opposite direction to the ion drift direction.

In accordance with an aspect of the present invention, the decreasing intervals have a ratio of 1.07^{n-1}:...:1.07:1, where n is a number of the electrode structures in the ion drift tube.

In accordance with an aspect of the present invention, the inner edge of the annular electrode has a substantially tapered shape.

In accordance with an aspect of the present invention, a cross sectional area of a space defined by the inner edge of the annular electrode increases gradually in an ion drift direction.

In accordance with an aspect of the present invention, the ion drift tube further comprises an insulation part disposed between the electrode structures.

In accordance with an aspect of the present invention, the

electrode structure has recesses on both sides at an outer peripheral portion, and both ends of the insulation part are disposed in the recesses.

In accordance with a further aspect of the present invention, the present invention provides an ion drift tube, the ion drift tube comprises electrode structures arranged at intervals, and the electrode structures are arranged at decreasing intervals in an opposite direction to an ion drift direction.

In accordance with an aspect of the present invention, the decreasing intervals have a ratio of 1.07^{n-1}:...:1.07:1, where n is a number of the electrode structures in the ion drift tube.

c. Advantageous technical effect

In the ion drift detection instrument with the electrode structure and the ion drift tube of the present invention, ions in a drift state can travel along focusing electric lines of force, and since the high-voltage intervals between the electrodes are increased at a uniform acceleration, the generated electric field enables the ions to be in a uniformly accelerated drift state so that both the sensitivity and resolution of the mobility spectrum of the detection instrument can reach optimum.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view showing a structure of a conventional ion drift tube;

FIG. 2 is a schematic view showing an electrode structure for an ion drift tube according to an embodiment of the present invention;

FIG. 3 is a schematic view showing a section of a central portion of the electrode structure for an ion drift tube according to an embodiment of the present invention; and

FIG. 4 is a schematic view showing a structure of an ion drift tube according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

An electrode structure for an ion drift tube and an ion drift tube including the electrode structure according to the present invention are described in detail as below with reference to embodiments of the present invention taken in conjunction with the accompanying drawings.

As shown in FIG. 2, an electrode structure for an ion drift tube according to an embodiment of the present invention comprises an annular electrode. The annular electrode is hollow in a central portion and has an inner edge bent towards one side such that a section of the central portion of the annular electrode has a swallowtail shape as shown in FIG. 3. With such an arrangement in which an opening on one side of the annular electrode is contracted and an opening on the other side of the annular electrode is enlarged, the electric field applied to ions has a focusing function so as to force the ions in a drift state to travel along

focusing electric lines of force.

As shown in FIGS. 1-2, the electrode structure is formed with recesses 5 on opposite sides at an outer peripheral portion, and opposite ends of the insulation part 3 are disposed in the recesses 5.

As shown in FIG. 4, an ion drift tube according to an embodiment of the present invention comprises the electrode structures 2 arranged at intervals as shown in FIG. 2, and the insulation parts 3 mounted between the electrode structures 2. The inner edges of the annular electrodes of the electrode structures are bent in a same direction, i.e., bent in an opposite direction to an ion drift direction, and generally bent towards a Faraday plate in the ion drift detection instrument. The electrode structures are also arranged at decreasing intervals in a direction toward the Faraday plate. The decreasing intervals have a ratio of 1.07^{n-1}:...:1.07:1, where n is a number of the electrode structures in the ion drift tube. The conventional intervals have a ratio of 1:1:...:1. The intervals are changed from the conventional intervals to the decreasing intervals. The high-voltage intervals between the electrodes enables the ions in a chamber of the ion drift tube to drift in a uniformly accelerated state, and in cooperation with the electrode structures having the focusing function, enable the sensitivity and resolution of the mobility spectrum to reach optimum when the ions finally arrive at the Faraday plate.

The above embodiments are only used to explain the present

invention, and should not be construed to limit the present invention. It will be understood by those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the present invention, the scope of which is defined in the appended claims and their equivalents.

CLAIMS

1. An electrode structure for an ion drift tube comprising: an annular electrode, wherein the annular electrode has an inner edge bent towards one side such that a section of a central portion of the annular electrode has a swallowtail shape.

2. The electrode structure of claim 1, wherein the inner edge of the annular electrode has a substantially tapered shape.

3. An ion drift tube, comprising the electrode structures according to claim 1 arranged at intervals, wherein the inner edges of the annular electrodes of the electrode structures are bent in a same direction, and the same direction is opposite to an ion drift direction.

4. The ion drift tube of claim 3, wherein the electrode structures are arranged at decreasing intervals in a direction opposite to the ion drift direction.

5. The ion drift tube of claim 4, wherein the decreasing intervals have a ratio of 1.07^{n-1}:...:1.07:1, where n is a number of the electrode structures in the ion drift tube.

6. The ion drift tube of claim 3, wherein the inner edge of the annular electrode has a substantially tapered shape.

7. The ion drift tube of claim 3, wherein a cross sectional area of a space defined by the inner edge of the annular electrode increases

gradually in an ion drift direction.

8. The ion drift tube of claim 3, further comprising an insulation part disposed between the electrode structures.

9. The ion drift tube of claim 8, wherein the electrode structure has recesses on opposite sides at an outer peripheral portion, and opposite ends of the insulation part are disposed in the recesses.

10. An ion drift tube, comprising electrode structures arranged at intervals, and the electrode structures are arranged at decreasing intervals in a direction opposite to a ion drift direction.

11. The ion drift tube of claim 10, wherein the decreasing intervals have a ratio of 1.07^{n-1}:...:1.07:1, where n is a number of the electrode structures in the ion drift tube.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/086514

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H01J /-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNTXT, DWPI, USTXT, JPTXT, EPTXT: ELECTRODE STRUCTURE ION MIGRATION TUBE ANNULAR EDGE BEND CENTRE DOVETAIL SHAPE PART

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 202373552 U (NUCTECH CO., LTD.), 08 August 2012 (08.08.2012), description, page 2, claims 1-4, and figures 1-4	1-11
X	WO 2010136779 A1 (MICROMASS UK LTD.), 02 December 2010 (02.12.2010), pages 15-17, and figures 1-6	1-2
A		3-11
X	US 2010282957 A1 (THERMO FINNIGAN LLC), 11 November 2010 (11.11.2010), paragraphs 21-31, figures 1 and 2, and abstract	10
A		11

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 March 2013 (05.03.2013)	**14 March 2013 (14.03.2013)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **HUANG, Chong** Telephone No.: (86-10) **62411882**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/086514

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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CN 202373552 U	08.08.2012	None	

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/086514

CONTINUATION: A. CLASSIFICATION OF SUBJECT MATTER

H01J 49/26 (2006.01) i

H01J 49/02 (2006.01) i