

CLAIMS

What is claimed is:

1. A gas chromatography device for peak focusing of one or more target analytes, comprising:
 - 5 a chromatographic column with an inlet and an outlet, wherein the inlet receives a sample comprising one or more target analytes that exits the chromatographic column at the outlet; and
 - a stationary phase deposited inside the chromatographic column and having a positive thickness gradient, wherein the stationary phase extends from the inlet to the outlet and has a first thickness at the inlet of the chromatographic column and a second thickness at the outlet of the chromatographic column, wherein the second thickness is at least about 10% greater than the first thickness.
2. The gas chromatography device of claim 1, wherein the first thickness is greater than or equal to about 10 nm to less than or equal to about 10 micrometers and the second thickness is greater than or equal to about 30 nm to less than or equal to about 30 micrometers.
3. The gas chromatography device of claim 1, wherein the second thickness is at least about 100% greater than or equal to the first thickness.
4. The gas chromatography device of claim 1, wherein the second thickness is at least about 300% greater than or equal to the first thickness.
5. The gas chromatography device of claim 1, wherein the chromatographic column is a microgas chromatographic column.
6. The gas chromatography device of claim 1, wherein the stationary phase comprises a siloxane polymer.
7. The gas chromatography device of claim 6, wherein the siloxane polymer comprises at least one alkyl group or aryl group comprising 1 to 30 carbon atoms.
8. The gas chromatography device of claim 1, wherein a cross-sectional shape of the chromatographic column is selected from the group consisting of: circular, oval, rectangular, and triangular.

9. A method of peak focusing in a gas chromatography device, comprising:
introducing two or more target analytes into an inlet of a chromatographic column comprising a stationary phase deposited inside the chromatographic column and having a positive thickness gradient, wherein the stationary phase extends from the inlet to an outlet and
5 has a first thickness at the inlet of the chromatographic column and a second thickness at the outlet of the chromatographic column, wherein the second thickness is at least about 10% greater than the first thickness;
separating two or more target analytes in the chromatographic column; and
eluting the two or more target analytes from the outlet of the chromatographic column.
10. The method of claim 9, wherein the two or more target analytes are volatile organic compounds (VOCs).
11. The method of claim 9, wherein at least one of the two or more target analytes comprises an aromatic compound and an overall peak focusing rate for the aromatic compound is greater than or equal to about 25%.
12. The method of claim 9, wherein at least one of the two or more target analytes comprises an alkane compound and an overall peak focusing rate for the alkane compound is greater than or equal to about 10%.
13. The method of claim 9, wherein the first thickness is greater than or equal to about 10 nm to less than or equal to about 10 micrometers and the second thickness is greater
20 than or equal to about 30 nm to less than or equal to about 30 micrometers.
14. The method of claim 9, wherein the second thickness is at least about 300% greater than or equal to the first thickness.
15. The method of claim 9, wherein the chromatographic column is a microgas chromatographic column.
16. The method of claim 9, wherein the stationary phase comprises a siloxane polymer comprising at least one alkyl group or aryl group comprising 1 to 30 carbon atoms.
17. The method of claim 9, wherein a cross-sectional shape of the chromatographic column is selected from the group consisting of: circular, oval, rectangular, and triangular.

18. A method of verifying peak focusing in a gas chromatography device, comprising:
conducting a forward operation by introducing two or more target analytes into an inlet
of a chromatographic column comprising a stationary phase deposited inside the chromatographic
column and having a positive thickness gradient, wherein the stationary phase extends from the
inlet to an outlet of the chromatographic column and has a first thickness at the inlet of the
5 chromatographic column and a second thickness at the outlet, wherein the second thickness is at
least about 10% greater than the first thickness;
separating the two or more target analytes in the chromatographic column;
eluting the two or more target analytes from the outlet of the chromatographic column;
10 conducting a reverse operation by introducing the two or more target analytes into the
outlet of the chromatographic column comprising the stationary phase;
separating the two or more target analytes in the chromatographic column;
eluting the two or more target analytes from the inlet of the chromatographic column; and
comparing chromatographic resolutions from the forward operation and the reverse
15 operation, wherein a peak focusing rate for at least one corresponding pair of two peaks from
two target analytes is greater than 5%.

19. A method of creating a gas chromatography device having a chromatographic
column with a positive thickness gradient, the method comprising:
introducing a precursor liquid into the chromatographic column, wherein the precursor
20 liquid comprises a stationary phase precursor and a low boiling point solvent that volatilizes
along a length of the chromatographic column to increase a concentration of the stationary phase
precursor when it moves along the chromatographic column; and
reacting or cross-linking the stationary phase precursor to form the positive thickness
gradient stationary phase extending from the inlet to the outlet and having a first thickness at the
25 inlet of the chromatographic column and a second thickness at the outlet of the chromatographic
column, wherein the second thickness is at least about 10% greater than the first thickness.

20. The method of claim 19, wherein prior to introducing the precursor liquid,
silanizing an interior surface of the chromatographic column.

21. The method of claim 20, wherein the silanizing comprises passing a reactive
30 silane in a gas phase through the chromatographic column.

22. The method of claim 19, wherein the chromatographic column comprises an inlet and an outlet and the introducing and reacting or cross-linking comprises dynamically coating an interior surface of the chromatographic column by partial filling the chromatographic column with the precursor liquid, applying a pressure at the inlet to force the precursor liquid down a
5 length of the chromatographic column, and applying a vacuum to the outlet to vaporize the low boiling point solvent.

23. The method of claim 19, wherein the first thickness is greater than or equal to about 10 nm to less than or equal to about 10 micrometers and the second thickness is greater than or equal to about 30 nm to less than or equal to about 30 micrometers.

10 24. The method of claim 19, wherein the second thickness is at least about 100% greater than or equal to the first thickness.

25. The method of claim 19, wherein the second thickness is at least about 300% greater than or equal to the first thickness.

15 26. The method of claim 19, wherein the chromatographic column is a microgas chromatographic column.

27. The method of claim 19, wherein the positive thickness gradient stationary phase comprises a siloxane polymer.

28. The method of claim 27, wherein the siloxane polymer comprises at least one alkyl group or aryl group comprising 1 to 30 carbon atoms.