

CLAIMS

1. A fluid distributing device (100) for a thin-film deposition apparatus, comprising:
 - an expansion region (101) comprising sub-regions (101-1, 101-2) for receiving fluid streams (F1, F2) via at least one inlet (103) arranged on each sub-region such that said fluid streams (F1, F2) propagate through the sub-regions in directions essentially towards one another, and
 - a transition region (102), in which fluid streams (F1, F2) arriving thereto via the sub-regions (101-1, 101-2) combine,
- 10 wherein each sub-region (101-1, 101-2) has an interior with a distance thereacross increasing on a cross-sectional plane between each inlet (103) and the transition region (102) to an expansion width (D1) in a direction of fluid flow (F1, F2); and
wherein the transition region (102) is configured to direct a combined fluid stream into a reaction chamber of the deposition apparatus, such that a flow (F) established at an entrance to the reaction chamber and propagating through the length of said reaction chamber is laminar.
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2. The device of claim 1, in which a fluidic flow established in the interior of each sub-region (101-1, 101-2) at a distance between the inlet (103) and the transition region (102) is laminar.
- 20 3. The device (100) of any one of claims 1 or 2, wherein the transition region (102) is a channel (102A-102B) with an entrance (102A) and an exit (102B) provided as openings having a width (d2, d2') and a length that extends at the distance (D1) corresponding to the expansion width of each sub-region (101-1, 101-2).
4. The device of any preceding claim, wherein the transition region (102) further comprises a constriction zone (104) formed by inclination of lateral surfaces (112, 121) of the channel (102A-102B) to a width (d3) essentially constant at the distance (D1).
- 25 5. The device (100) of any preceding claim, wherein at least a portion of the channel (102A-102B) has lateral surfaces inclined at a curvature.

6. The device (100) of any preceding claim, wherein the sub-regions (101-1, 101-2) of the expansion region (101) are disposed at a cross-sectional plane (P1) essentially orthogonal to a longitudinal axis (Y) of the deposition apparatus.
7. The device (100) of any preceding claim, wherein the direction of the fluid streams (F1, F2) propagating through the expansion region (101) is essentially perpendicular to the direction of fluid flow (F) propagating through the reaction chamber (201).
8. The device (100) of any preceding claims 1-5, wherein the sub-regions (101-1, 101-2) of the expansion region (101) are each disposed at cross-sectional planes (P1') and wherein each such plane (P1') is inclined by an angle (α) with regard to the cross-sectional plane (P1).
9. The device (100) of claim 8, wherein the cross-sectional planes (P1') are mirror-symmetrical.
10. The device (100) of any preceding claim, wherein, at the transition region (102), each fluid stream (F1, F2) makes a turn from the cross-sectional plane (P1, P1') to a cross-sectional plane (P2) defined as a plane of symmetry for the sub-regions (101-1, 101-2) along the longitudinal axis (Y) of the deposition apparatus.
11. The device of any preceding claim, wherein the sub-regions (101-1, 101-2) have height (h1) essentially constant across the interior thereof.
12. The device of any preceding claim, further comprising a flow-shaping element (105) configured to adjust a flow direction of fluid streams (F1, F2) entering the transition region (102) essentially towards the reaction chamber (201).
13. The device of any preceding claim, further comprising a mixing arrangement (106) in the transition region (102).
14. The device of any preceding claim, further comprising a plasma generating arrangement (107), optionally disposed in the transition region (102).
15. A thin-film deposition apparatus (200) comprising:
 - a reaction chamber (201) for accommodating substrates (10) arranged with their side faces adjacent to each other; and
 - a fluid distributing device (100), comprising an expansion region (101) with sub-regions (101-1, 101-2) into which fluid streams (F1, F2) are received via

at least one inlet (103) arranged on each sub-region such that said fluid streams (F1, F2) propagate through the sub-regions in directions essentially towards one another, and a transition region (102), in which fluid streams (F1, F2) arriving thereto via the sub-regions (101-1, 101-2) combine;

5 wherein each sub-region (101-1, 101-2) has an interior with a distance thereacross increasing on a cross-sectional plane between each inlet (103) and the transition region (102) to an expansion width (D1) in a direction of fluid flow (F1, F2); and

wherein the transition region (102) is configured to further direct a combined fluid stream into the reaction chamber (201), such that a flow (F) established at an
10 entrance to the reaction chamber and propagating through the length of said reaction chamber, between the side faces of the substrates (10), is laminar.

16. The apparatus (200) of claim 15, comprising the fluid distributing device (100) implemented according to what is defined in any one of claims 1-14.

15 17. The apparatus (200) of any one of claims 15 or 16, wherein the reaction chamber (201) has a constant cross-section throughout its length.

18. The apparatus (200) of any preceding claims 15-17, wherein the transition region (102) is established by a channel (102A-102B) with an entrance opening (102A) and an exit opening (102B), and wherein said entrance opening and/or said exit opening have the same cross-section as the reaction chamber (201).

20 19. The apparatus (200) of any preceding claims 15-18, wherein an interior of the reaction chamber (201) dimensionally conforms to a predetermined number of the substrates (10) received thereinto.

20. The apparatus (200) of any preceding claims 15-19, configured to deposit material on substrate surfaces by establishing a laminar flow (F) of a precursor fluid (12)
25 through the length of the reaction chamber (201), wherein the precursor fluid propagates between the side faces of said substrates (10) with essentially uniform velocity at a leading edge.

21. The apparatus (200) of any preceding claims 15-20, wherein the precursor fluid (12) delivered into the reaction chamber comprises at least one precursor (12X, 12A,
30 12B, 12C, 12D, 12E, 12F, 12G).

22. The apparatus (200) of any preceding claims 15-21, wherein the precursor fluid (12) is delivered into the reaction chamber in a number of sequential pulses.
23. The apparatus (200) of any preceding claims 15-22, configured to deposit a coating film simultaneously on all substrate surfaces.
- 5 24. The apparatus (200) of any preceding claims 15-23, further comprising an exhaust conduit (41) and an enclosure (42) arranged essentially around said exhaust conduit (41) and receiving fluid flowing from the reaction chamber (201) through the conduit (41), wherein said exhaust conduit (41) and said enclosure (42) form an exhaust assembly configured to alter a direction of exhaust flow (Fex) exiting the
10 reaction chamber (201).
25. The apparatus of claim 24, wherein the exhaust conduit (41) and the enclosure (42) form a passage, in which exhaust flow (Fex) exiting the reaction chamber (201) via the exhaust conduit (41) makes a turn around a wall or walls forming said conduit (41), while remaining in the enclosure (42), to be further directed into an exhaust
15 manifold (40) via an aperture (42A) arranged on at least one sidewall of the enclosure (42).
26. The apparatus (200) of any preceding claims 15-25 configured as an apparatus for chemical deposition reactions.
27. The apparatus (200) of any preceding claims 15-26 configured as an apparatus for
20 Atomic Layer Deposition (ALD).
28. A method for depositing material on substrate surfaces in an apparatus for thin-film deposition, comprising:
- obtaining a thin-film deposition apparatus (200) that comprises a reaction chamber (201) for accommodating substrates (10) arranged with their side
25 faces adjacent to each other; and a fluid distributing device (100) that comprises an expansion region (101) comprising sub-regions (101-1, 101-2) and a transition region (102);
 - establishing a flow of fluid (F1, F2) into the sub-regions (101-1, 101-2) via
30 at least one inlet (103) arranged on each sub-region such that fluid streams (F1, F2) propagate through the sub-regions in directions essentially towards one another, wherein at least one fluid stream (F1, F2) comprises at least one precursor (12X, 12A, 12B, 12C, 12D, 12E, 12F, 12G);

- combining fluid streams (F1, F2) in the transition region (102), whereby a precursor fluid is formed comprising at least one precursor (12X, 12A, 12B, 12C, 12D, 12E, 12F, 12G), and further directing said precursor fluid into the reaction chamber (201); and
- 5 - depositing material on substrate surfaces by establishing a laminar flow (F) of precursor fluid at an entrance to the reaction chamber and maintaining said laminar flow upon propagating said precursor fluid between the side faces of the substrates (10) through the length of said reaction chamber,
- 10 wherein each said sub-region (101-1, 101-2) has an interior with a distance thereacross increasing on a cross-sectional plane (P1, P1') between each inlet (103) and the transition region (102) to an expansion width (D1) in a direction of fluid flow (F1, F2).
29. The method of claim 28, wherein precursor fluid propagates between the substrates (10) with essentially uniform velocity at a leading edge.
- 15 30. Use of the apparatus (200), as defined in any one of claims 15-27 for depositing thin films of coating material on substrate surfaces.
31. A thin-film deposition system (500A, 500B, 500C, 500D) comprising a number of apparatuses (200), as defined in any one of claims 15-27, connected to one another in sequence and/or in an array.
- 20 32. The system of claim 31, in which the apparatuses (200) are arranged such, as to receive a common precursor compound (12X, 12A, 12B, 12C, 12D, 12E, 12F, 12G) into at least two apparatuses.
33. A method for uniform distribution of fluids in an apparatus for thin-film deposition, comprising:
- 25 - obtaining a thin-film deposition apparatus (200) that comprises a reaction chamber (201) for accommodating substrates (10) arranged with their side faces adjacent to each other; and a fluid distributing device (100) that comprises an expansion region (101) with sub-regions (101-1, 101-2) and a transition region (102);
- 30 - establishing a flow of fluid (F1, F2) into the sub-regions (101-1, 101-2) via at least one inlet (103) arranged on each sub-region such that fluid streams

(F1, F2) propagate through the sub-regions in directions essentially towards one another;

- combining fluid streams (F1, F2) in the transition region (102), and
- directing a combined fluid stream into the reaction chamber (201) such that a flow (F) established at an entrance to the reaction chamber and propagating through the length of said reaction chamber, between the side faces of the substrates (10), is laminar,

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wherein each said sub-region (101-1, 101-2) has an interior with a distance thereacross increasing on a cross-sectional plane (P1, P1') between each inlet (103) and the transition region (102) to an expansion width (D1) in a direction of fluid flow (F1, F2);

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wherein an interior of the reaction chamber (201) dimensionally conforms to a predetermined number of substrates (10) received thereinto; and

wherein, at the transition region (102), each fluid stream (F1, F2) makes a turn from the cross-sectional plane (P1, P1') to a cross-sectional plane (P2) defined as a plane of symmetry for the sub-regions (102-1, 102-2) along a longitudinal axis (Y) of the deposition apparatus.

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