and the second process microchannel being adjacent to the liquid channel, the liquid channel comprising a wicking region, part of the wicking region forming a wall of the first process microchannel and a wall of the second process microchannel,

the liquid phase flowing through the wicking region,

the vapor phase flowing through the vapor inlet into the first vapor channel, through the first vapor channel into the first process microchannel, through the first process microchannel in contact with at least part of the liquid phase in the wicking region, from the first process microchannel into the second vapor channel, through the second vapor channel into the second process microchannel, through the second process microchannel in contact with at least part of the liquid phase in the wicking region, from the second process microchannel into the third vapor channel, and through the third vapor channel into the vapor outlet.

13. The process of claim 2 wherein the process microchannel has an internal dimension of width or height of up to about 10 mm.

14. The process of claim 2 wherein the process microchannel has an internal dimension of width or height of up to about 2 mm.

15. The process of claim 2 wherein the process microchannel is made of a material comprising: steel; monel; inconel; aluminum; titanium; nickel; copper; brass; an alloy of any of the foregoing metals; a polymer; ceramics; glass; a composite comprising a polymer and fiberglass; quartz; silicon; or a combination of two or more thereof.

16. The process of claim 2 wherein the liquid channel comprises a microchannel.

17. The process of claim 2 wherein the liquid channel has an internal dimension of width or height of up to about 10 mm.

18. The process of claim 2 wherein the liquid channel has an internal dimension of width or height of up to about 2 mm.

19. The process of claim 2 wherein the liquid channel is made of a material comprising: steel; monel; inconel; aluminum; titanium; nickel; copper; brass; an alloy of any of the foregoing metals; a polymer; ceramics; glass; a composite comprising polymer and fiberglass; quartz; silicon; silicon carbide; boron carbide; metal carbide; silicon nitride; boron nitride; metal nitride; or a combination of two or more thereof.

20. The process of claim 3 wherein the heat exchanger comprises at least one heat exchange channel having an internal dimension of width or height of up to about 10 mm.

21. The process of claim 3 wherein the heat exchanger comprises at least one heat exchange channel having an internal dimension of width or height of up to about 2 mm.

22. The process of claim 3 wherein the heat exchanger comprises at least one heat exchange channel made of a material comprising: steel; monel; inconel; aluminum; titanium; nickel; copper; brass; an alloy of any of the foregoing metals; a polymer; ceramics; glass; a composite comprising polymer and fiberglass; quartz; silicon; or a combination of two or more thereof.

23. The process of claim 4 wherein the capture structure comprises wire mesh.

24. The process of claim 4 wherein the capture structure comprises one or more of inverted cones, liquid-nonwetting porous structure, liquid-wetting porous structure, perforated foil, and fibers.

25. The process of claim 2 wherein the wicking region comprises a wick.

26. The process of claim 25 wherein the wick comprises one or more of sintered metal, metal screen, metal foam, and polymer fibers.

27. The process of claim 2 wherein the wicking region comprises a wicking surface.

28. The process of claim 27 wherein the wicking surface comprises grooves in one or more interior walls of the liquid channel.

29. The process of claim 28 wherein the grooves are aligned parallel to the direction of flow of the vapor phase in the process microchannel.

30. The process of claim 28 wherein the grooves are aligned tangentially to the direction of flow of the vapor phase in the process microchannel.

31. The process of claim 28 wherein the grooves provide a flow path for the liquid phase to the another microchannel distillation section.

32. The process of claim 1 wherein the flow fo the liquid phase is driven by gravitational forces.

33. The process of claim 1 wherein the flow of the liquid phase is driven by gravitational force and/or a pressure differential.

34. The process of claim 1 wherein the fluid mixture comprises ethane and ethylene.

35. The process of claim 1 wherein the fluid mixture comprises styrene and ethyl benzene.

36. The process of claim 1 wherein the fluid mixture comprises oxygen and nitrogen.

37. The process of claim 1 wherein the fluid mixture comprises cycohexane and cyclohexanol or cyclohexanone.

38. The process of claim 1 wherein the fluid mixture comprises isobutane.

39. The process of claim 1 wherein the fluid mixture comprises naptha.

40. The process of claim 3 wherein the heat exchanger comprises at least one heat exchange channel and an endothermic or exothermic process is conducted in the heat exchange channel.

41. The process of claim 40 wherein the exothermic process comprises a water-gas shift reaction, a methanol synthesis reaction or an ammonia synthesis reaction.

42. The process of claim 40 wherein the endothermic reaction comprises a steam reforming process or dehydrogenation process.

43. The process of claim 3 wherein the heat exchanger comprises at least one heat exchange channel, and a heat exchange fluid flows through the heat exchange channel.

44. The process of claim 43 wherein the heat exchange fluid undergoes a phase change in the heat exchange channel.

45. The process of claim 43 wherein the heat exchange fluid undergoes partial boiling in the heat exchange channel.

46. The process of claim 1 wherein the microchannel distillation sections have adjacent heat exchange channel zones, a heat exchange fluid flows in the heat exchange channel zones, the heat exchange fluid undergoing partial