

fluid mixture comprising a more volatile component and a less volatile component, the process comprising:

flowing a vapor phase of the fluid mixture in a first microchannel distillation section in contact with a liquid phase of the fluid mixture, part of the more volatile component transferring from the liquid phase to the vapor phase to form a more volatile component rich vapor phase, part of the less volatile component transferring from the vapor phase to the liquid phase to form a less volatile component rich liquid phase;

separating the more volatile component rich vapor phase from the less volatile component rich liquid phase;

flowing the less volatile component rich liquid phase to another microchannel distillation section upstream from the first microchannel distillation section; and

flowing the more volatile rich vapor phase to another microchannel distillation section downstream from the first microchannel distillation section.

2. The process of claim 1 wherein each microchannel distillation section comprises at least one process microchannel and at least one adjacent liquid channel, the liquid channel comprising a wicking region.

3. The process of claim 1 wherein the microchannel distillation unit further comprises a heat exchanger.

4. The process of claim 2 wherein for each microchannel distillation section the process microchannel comprises a liquid inlet for permitting liquid to flow into the process microchannel, a liquid outlet for permitting liquid to flow out of the process microchannel, an interior wall extending from the liquid entrance to the liquid exit, and a capture structure, the liquid outlet being downstream from the liquid inlet.

5. The process of claim 4 wherein the liquid phase flows along the surface of the interior wall, the liquid phase being in the form of a thin film.

6. The process of claim 2 wherein part of the wicking region forms a wall of the process microchannel.

7. The process of claim 6 wherein the liquid phase flows in the wicking region and the vapor phase flows in the process microchannel and contacts at least part of the liquid phase in the wicking region.

8. The process of claim 1 wherein the more volatile component rich vapor phase is a first section more volatile component rich vapor phase formed in the first microchannel distillation section of the process microchannel, the process microchannel comprising the first microchannel distillation section and downstream second and third microchannel distillation sections, the first section more volatile component rich vapor phase flowing from the first microchannel distillation section into the downstream second microchannel distillation section, a downstream third section less volatile component rich liquid phase formed in the downstream third microchannel distillation section flowing from the downstream third microchannel distillation section into the downstream second microchannel distillation section and contacting the first section more volatile component rich vapor phase in the downstream second microchannel distillation section, the downstream third section less volatile component rich liquid phase flowing in a thin film along an interior wall in the downstream second microchannel distillation section, part of the more volatile component transferring from the downstream third section less volatile

component rich liquid phase to the first section more volatile component rich vapor phase to form a downstream second section more volatile component rich vapor phase, part of the less volatile component transferring from the first section more volatile component rich vapor phase to the downstream third section less volatile component rich liquid phase to form a downstream second section less volatile component rich liquid phase; and

separating the downstream second section more volatile component rich vapor phase from the downstream second section less volatile component rich liquid phase.

9. The process of claim 1 wherein the less volatile component rich liquid phase is a first section less volatile component rich liquid phase formed in the first microchannel distillation section of the process microchannel, the process microchannel comprising the first microchannel distillation section and upstream second and third microchannel distillation sections, the first section less volatile component rich liquid phase flowing from the first microchannel distillation section into the upstream second microchannel distillation section, an upstream third section more volatile component rich vapor phase formed in the upstream third microchannel distillation section flowing from the upstream third microchannel distillation section into the upstream second microchannel distillation section and contacting the first section less volatile component rich liquid phase in the upstream second microchannel distillation section, the first section less volatile component rich liquid phase flowing in a thin film along an interior wall in the upstream second microchannel distillation section, part of the more volatile component transferring from first section less volatile component rich liquid phase to the upstream third section more volatile component rich vapor phase to form an upstream second section more volatile component rich vapor phase, part of the less volatile component transferring from the upstream third section more volatile component rich vapor phase to the first section less volatile component rich liquid phase to form an upstream second section less volatile component rich liquid phase; and

separating the upstream second section more volatile component rich vapor phase from the upstream second section less volatile component rich liquid phase.

10. The process of claim 2 wherein each microchannel distillation section further comprises a heat exchange channel adjacent to the liquid channel, the process microchannel, or both the liquid channel and the process microchannel.

11. The process of claim 4 wherein the microchannel distillation unit further comprises a first supplemental vapor channel and a second supplemental vapor channel, each microchannel distillation section further comprising a supplemental vapor inlet and a supplemental vapor outlet, part of the vapor phase flowing from the first supplemental vapor channel through the supplemental vapor inlet into the microchannel distillation section, through the microchannel distillation section in contact with the liquid phase, and through the supplemental vapor outlet to the second supplemental vapor channel.

12. The process of claim 1 wherein each microchannel distillation section comprises a liquid channel, a first process microchannel, a second process microchannel, a first vapor channel, a second vapor channel, a third vapor channel, a vapor inlet and a vapor outlet, the first process microchannel