

structure, a liquid inlet and a liquid outlet, the capture structure and the liquid outlet being downstream from the liquid inlet, the interior wall extending from the liquid inlet to the liquid outlet, the capture structure being suitable for capturing liquid and permitting vapor to flow through it, the liquid outlet being suitable for permitting the flow of liquid from the capture structure through the liquid outlet into the liquid channel, the liquid inlet being suitable for permitting liquid to flow from the liquid channel into the process microchannel; flowing a liquid phase of the fluid mixture through the liquid channel in a direction opposite to the direction of flow of the vapor phase in the process microchannel, the liquid channel including a wicking region, the liquid phase flowing through the wicking region; the liquid phase flowing from the liquid channel through the liquid inlet in a first microchannel distillation section of the process microchannel and flowing as a thin film along the interior wall to the capture structure within the first microchannel distillation section, the vapor phase flowing through the first microchannel distillation section in contact with the liquid phase flowing along the interior wall, 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, the less volatile component rich liquid phase contacting the capture structure and flowing from the capture structure through the liquid outlet of the first microchannel distillation section into the liquid channel, the more volatile component rich vapor phase flowing through the capture structure of the first microchannel distillation section.

[0020] In one embodiment, the invention relates to a process for separating ethylene from a fluid mixture comprising ethylene and ethane in a distillation unit comprising a plurality of microchannel distillation sections, the process comprising: contacting a vapor phase of the fluid mixture with a liquid phase of the fluid mixture in each of the microchannel distillation sections, progressively enriching the vapor phase with ethylene to form an ethylene enriched vapor phase, and separating the ethylene enriched vapor phase from the distillation unit, the distillation unit having a height of up to about 20 meters, the separated ethylene enriched vapor phase having an ethylene content of at least about 95% by volume.

[0021] In one embodiment, the invention relates to a process for distilling a fluid mixture in a distillation apparatus comprising a plurality of microchannel distillation units, each microchannel distillation unit comprising a plurality of microchannel distillation sections, the 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 of at least one of the microchannel distillation units 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 in the microchannel distillation unit upstream from

the first microchannel distillation section; and flowing the more volatile rich vapor phase to another microchannel distillation section in the microchannel distillation unit downstream from the first microchannel distillation section. In one embodiment, the distillation process is conducted in all of the microchannel distillation units in the distillation apparatus. In one embodiment, the distillation process is conducted in some but not all of the microchannel distillation units in the distillation apparatus.

[0022] In one embodiment, the invention relates to a microchannel distillation unit, comprising: a process microchannel and a liquid channel; the liquid channel being adjacent to the process microchannel, the liquid channel comprising a wicking region; the process microchannel comprising a plurality of microchannel distillation sections, each microchannel distillation section comprising an internal space for permitting vapor flow, an interior wall for permitting liquid to flow as a thin film along the interior wall, a capture structure for capturing liquid and permitting vapor to flow through it, a liquid outlet for permitting liquid to flow from the capture structure into the liquid channel, and a liquid inlet for permitting liquid to flow from the liquid channel into the process microchannel.

[0023] In one embodiment, the invention relates to a microchannel distillation unit, comprising: 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 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 first vapor channel being adjacent to the first process microchannel, the third vapor channel being adjacent to the second process microchannel, the second vapor channel being adjacent to the first and third vapor channels, the first and third vapor channels being positioned between the first and second process microchannels and the second vapor channel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] In the annexed drawings, like parts and features have like designations.

[0025] FIG. 1 is a flow sheet illustrating a distillation process that can be used in accordance with the inventive process.

[0026] FIG. 2 is a flow sheet illustrating an alternate embodiment of a distillation process that can be used in accordance with the inventive process.

[0027] FIG. 3 is a drawing illustrating the McCabe-Thiele graphical method for calculating the number of distillation sections for a distillation process.

[0028] FIG. 4 is a schematic illustration of a microchannel distillation unit that can be used in accordance with the inventive process.

[0029] FIG. 5 is a schematic illustration of a microchannel distillation unit that can be used in accordance with the inventive process.

[0030] FIG. 6 is a schematic illustration of a microchannel distillation unit that can be used in accordance with the inventive process.