[0082] The term "fluid" refers to a gas, a liquid, or a gas or a liquid containing dispersed solids, or a mixture thereof. The fluid may be in the form of a vapor or a gas containing dispersed liquid droplets.

$$\text{Suratmann number} = \frac{\sigma D_h P_L}{\mu_L^2}$$

[0083] where, σ=Surface tension of liquid, N/m

[0084] D_h=Hydraulic diameter of channel, m

[0085] ρ_L=Density of liquid, kg/m^3

[0086] μ_L=Viscosity of liquid, N-s/m^2

[0087] A "shim" is a thin sheet of metal having a thickness in the range from about 0.01 mm to about 2 mm that contains either partial or full features or both, for which multiple shims may be stacked and bonded to form a microchannel device.

[0088] A "surface feature" is a recessed or protruding feature in a microchannel that acts to perturb flow and enhance transverse and/or perpendicular flow and thus reduce mass transfer resistance in a liquid or vapor or both.

[0089] The inventive process will be described initially with reference to **FIG. 1**. Referring to **FIG. 1**, a microchannel distillation assembly **100** is provided for distilling a fluid mixture containing components X and Y. Component Y is more volatile than component X. The microchannel distillation assembly **100** includes microchannel distillation column or apparatus **110**, a microchannel condenser **120**, and microchannel reboiler **130**. The microchannel distillation column or apparatus **110** contains one or more microchannel distillation units (see, for example, microchannel distillation unit **400** in **FIG. 14**) which are provided for separating component X from component Y. Each of the microchannel distillation units may comprise a plurality of microchannel distillation sections or stages (see, for example, microchannel distillation sections **450**, **450***a* and **450***b* in **FIG. 14**). In operation, a feed F comprising a fluid mixture (i.e., gas, liquid, or mixture of gas and liquid) comprising components X and Y enters a microchannel distillation column or apparatus **110**, as indicated by arrow **112**. Within the microchannel distillation column or apparatus **110***a* vapor phase flows through a series of the microchannel distillation sections in a direction towards the microchannel condenser **120** and a liquid phase flows through a series of the microchannel distillation sections in a direction towards the microchannel reboiler **130**. In each microchannel distillation section the vapor phase and the liquid phase contact each other with the result being a mass transfer between the phases. In each microchannel distillation section part of the more volatile component Y transfers from the liquid phase to the vapor phase, and part of the less volatile component X transfers from the vapor phase to the liquid phase. The vapor phase, which is progressively enriched with the more volatile component Y, flows through microchannel distillation column or apparatus **110** towards the microchannel condenser **120** and into the microchannel condenser **120**. The liquid phase, which is progressively enriched with the less volatile component X, flows through the microchannel distillation column or apparatus **110** towards the microchannel reboiler **130** and into the microchannel reboiler **130**. The vapor phase may be fully or partially condensed in the microchannel condenser **120** to form distillate product D. Part of the distillate product D, which may be referred to as an overhead product (sometimes called a head or a make), may be withdrawn from the system, as indicated by arrow **122**. Part of the distillate product D may be returned to the microchannel distillation column or apparatus **110** where it flows through the microchannel distillation unit in the form of a liquid phase. The liquid phase, in the form of bottoms product B may flow into the microchannel reboiler **130**. Part of the bottoms product B may be withdrawn from the system, as indicated by arrow **132**. Part of the bottoms product may be fully or partially vaporized in the microchannel reboiler **130** and returned to the microchannel distillation column or apparatus **110** where it flows through the microchannel distillation column or apparatus **110** in the form of a vapor phase. The ratio between the amount of distillate product D that is removed from the system and the amount that is returned to the system may be referred to as the reflux ratio. The ratio between the amount of bottoms product B that is removed from the system and the amount that is returned to the system may be referred to as the boil-up ratio. These ratios can vary and can be determined by those skilled in the art.

[0090] In one embodiment, the microchannel distillation assembly **100** may be constructed without the microchannel condenser **120**. In this embodiment, the microchannel distillation assembly **100** may comprise the microchannel distillation column or apparatus **110** and the microchannel reboiler **130**. In this embodiment the microchannel distillation assembly **100** may be used as a stripping column.

[0091] In one embodiment, the microchannel distillation assembly **100** may be constructed without the microchannel reboiler **130**. In this embodiment, the microchannel distillation assembly **100** may comprise the microchannel distillation column or apparatus **110** and the microchannel condenser **120**. In this embodiment the microchannel distillation assembly **100** may be used in operations where a relatively hot fluid is added in a lower microchannel distillation section or stage. An example of such a use would be a steam stripper.

[0092] When used the microchannel condenser **120** and/or reboiler **130** may be in the form of one of the microchannel distillation sections or stages (see, for example, microchannel distillation sections **450**, **450***a* and **450***b* in **FIG. 14**) used in the microchannel distillation column or apparatus **110**.

[0093] The inventive process will now be described with reference to **FIGS. 2, 4, 5** and **12**. Referring to **FIGS. 2, 4, 5** and **12**, a process for distilling a fluid mixture in a microchannel distillation assembly **200** is provided. The microchannel distillation assembly **200** comprises at least one, and in one embodiment a plurality of microchannel distillation columns or apparatuses **210**. In **FIG. 4**, four microchannel distillation units, namely, microchannel distillation columns or apparatuses **210**, **210***i*, **210***ii* and **210***iii*, are shown, however, it is to be understood that any number of microchannel distillation columns or apparatuses **210** may be used in the microchannel distillation assembly **200**, for example, one, two, three, four, six, eight, ten, tens, hundreds, thousands, etc., may be used. Each microchannel distillation column or apparatus **210** may be housed within