Further, one could imagine a microchannel wine making device with the active yeast bound on the microchannel walls to initiate the fermentation reaction coupled with microchannel heat removal (including partial boiling) on an adjacent wall. Further, the yeast could be adapted to the microchannel walls in a manner that either includes oak or other wood products. Further, one side of the microchannel wall, where the wine is produced, could be made from a disposable oak or other wood product array of wine synthesis channels. Alternatively, the entire device could be made from wood or material that enhances the product quality.

[0179] For a system where coolant flows through a matrix of aligned microchannels are used to remove a constant heat flux from a saturated inlet stream, small differences in the inlet channel mass flow rates from the average or target for the case of a tailored distribution can lead to large differences in outlet vapor quality and affect coolant flow distribution. Should a manifold design not ensure equal flows or nearly equal flows with a quality index factor less than 10% (quality factor is described in U.S. printed patent application Ser. No. 2005/0087767) through a matrix of equivalent connecting channels with the same wall heat flux, the channel with a lower mass flow rate than specified, it is expected that the constant heat input would increase the local quality throughout the channel and incur a larger pressure drop. This is seen in the Lockhart-Martinelli pressure drop equation (2) that has local quality dependencies of first and second order. Those channels to which the manifold delivers more flow will see a lower outlet quality than specified and conversely a lower local quality throughout the channel. The additional effect is a feedback mechanism that rewards a lower quality channel with more flow and penalizes a higher quality stream with less flow, further exacerbating flow maldistribution. This latter effect is dangerous for operation when the desired operation range is near the critical heat flux for the design flow rates. In those cases a flow maldistribution can lead to local heat removal instability that can endanger the unit operation being controlled by partial boiling. This is a major development challenge in the development of partial boiling systems.

[0180] The production of steam from convective boiling in nuclear reactors could be another application in which partial boiling could be crucial in temperature control. Convective boiling is used in cooling nuclear reactors, and potentially the inventions can. increase the critical heat flux the system can handle, and proper manifold design can be used to remove large heat fluxes that would give rise to dangerous reactor operation.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0181] **FIG. 1**. Schematic of boiling flow patterns in a microchannel

[0182] **FIG. 2**. A typical boiling curve

[0183] **FIG. 3**. Wall Superheat for Nucleation.

[0184] **FIG. 4**. Boiling curves; effects of porous structure and pin fin.

[0185] **FIG. 5**. Heat flux curve from process side vs. CHF curve

[0186] **FIG. 6**. Cooling Channel Split to increase CHF

[0187] **FIG. 7**. Cooling channels subdivided into 3 channels. A process channel is disposed above and/or below the plane of the page.

[0188] **FIG. 8**. Cooling channel with varying gap size.

[0189] **FIG. 9**. Schematic of device for partial boiling

[0190] **FIG. 10**. Schematic of thermocouple locations in device of **FIG. 9**.

[0191] **FIG. 11**. Schematic of test loop for testing partial boiling device of **FIG. 9**.

[0192] **FIG. 12**: Variation of wall temperature along the flow length at different heat fluxes

[0193] **FIG. 13**: Variation of outlet quality or void fraction with heat flux

[0194] **FIG. 14**: Effect of mass flow rate on wall temperature profile

[0195] **FIG. 15**. Pressure drop as a function of average heat flux for the 24 inch partial boiling test device.

[0196] **FIG. 16**. The overance temperature vs. boiling number.

[0197] **FIG. 17**. The overance temperature vs. SR ratio.

[0198] **FIG. 18** Micro-channel reactor for VAM production.

[0199] **FIG. 19**. Heat flux profile on the channel wall (mass flow rate on the process side is 146.2 $Kg/m^2s$).

[0200] **FIG. 20**. Temperature profiles along the reactor length using different heat removal schemes. (mass flow rate on the process side is 146.2 kg/m2/s, $T_{in}$=160° C.).

[0201] **FIG. 21**. Temperature curves along centerline of catalyst bed for the microchannel VAM reactor. Comparison of partial boiling with single phase convection heat transfer Tin (process)=180° C.; Tin (cooling)=180° C.; V (cooling)=0.3 m/s

[0202] **FIG. 22***a*. Main body of an FT reactor according to Example 5. The holes on the top face are thermowells.

[0203] **FIG. 22***b*. Exploded view of the reactor and the weldment of Ex. 5.

[0204] **FIG. 22***c*. Time on stream temperatures for the multichannel cross-flow Fisher-Tropsch reactor of Ex. 5. "TC" is an abbreviation for thermocouple.

[0205] **FIG. 23**. Low Pressure Vaporizer Device Body with Water Side Header and Footer. The air header and footer are not shown.

[0206] **FIG. 24**. Low Pressure Vaporizer Device Body with Air Side Header and Footer. The water header and footer are not shown.

[0207] **FIG. 25**. Low Pressure Vaporizer Water Header

[0208] **FIG. 26**. Partial Vaporizer System Sketch.

[0209] **FIG. 27**. Low Pressure Vaporizer, 1-2 ppm total dissolved solids.

[0210] **FIG. 28**. Low Pressure Vaporizer, dirty water feed.

[0211] **FIG. 29**: Cross-sectional schematic of a microchannel vaporizer