a fluid passage) measured in any cross section that is perpendicular to thickness. A minimum dimension means that the flow path cannot be smaller than the recited dimension at any point along the path through the specified number of sheets.

[0034] A "microchannel" has at least one dimension of 2 mm or less.

[0035] "Shims" refer to substantially planar plates or sheets that can have any width and height and preferably have a thickness (the smallest dimension) of 5 millimeter (mm) or less, and in some preferred embodiments between 50 and 1000 μm. In this disclosure, a set of identical shims (or sheets) that are bonded together may also be called a shim.

[0036] That a "straight, unobstructed line is present through the flow path (or, equivalently, fluid passage)" does not mean that the entire flow path must be straight and unobstructed, nor that a portion of the flow path is completely free from any projections, but rather that at least a portion of the flow path is straight and unobstructed such that a straight rod (having a finite thickness, i.e. a rod that is not infinitely thin) could be placed in the flow path through the entire thickness of the recited number of shims; the flow path includes but is not limited to a straight and unobstructed flow path. A flow path that contains a membrane, porous film or perforated sheet is not considered "unobstructed."

[0037] By "substantially parallel to sheet (or shim) thickness" it is meant substantially perpendicular to sheet (or shim) width, and permitting of some curvature or minor, or partial deviation from 90° with respect to shim width. A flow path that travels parallel to shim thickness over the surface of a shim, through an opening in an adjacent shim, and down to the surface of another shim and again runs parallel to shim thickness, is not "substantially parallel to sheet (or shim) thickness;"alternatively stated, "substantially parallel to sheet (or shim) thickness" does not include flow through headers/footers in the first shim style.

[0038] "Unit operation" means chemical reaction, vaporization, compression, chemical separation, distillation, condensation, heating, and cooling. "Unit operation" does not mean merely mixing or fluid transport, although mixing and transport frequently occur along with unit operations.

BRIEF DESCRIPTION OF THE FIGURES

[0039] **FIG. 1***a* illustrates a laminated device in which flow is substantially perpendicular to sheet thickness.

[0040] **FIG. 1***b* illustrates another laminated device in which flow is substantially perpendicular to sheet thickness.

[0041] **FIG. 2** illustrates another style of a laminated device in which flow is substantially perpendicular to sheet thickness.

[0042] **FIG. 3** illustrates one type of laminated device made in the ortho style.

[0043] **FIG. 4***a* illustrates overhead views of shims, in which the dark area is shim material and the light areas are apertures that can stack with identical shims to form tubular channels.

[0044] **FIG. 4***b* illustrates shims with triangular or clamshell-shaped apertures that can be stacked to form prismatic or hemispheric channels.

[0045] **FIG. 4***c* illustrates shims with irregularly shaped apertures that can be stacked to form irregularly-shaped channels.

[0046] **FIG. 4***d* illustrates shims with shims with oblong apertures containing fins that can be stacked to form elongated, fin-containing tubes.

[0047] **FIG. 4***e* is a representation of a 3-dimensional device formed by laminating shims of the type shown in the center of **FIG. 4***d*.

[0048] **FIG. 4***f* illustrates shims with groups of oval-shaped apertures that could be stacked to form groups of oval-shaped tubes.

[0049] **FIG. 4***g* illustrates a semi-ortho concept. In the specific design illustrated, a reactor includes integral heat recuperation of the reactant and product stream.

[0050] **FIG. 5***a* illustrates shims with groups of circular apertures that could be stacked to form groups of cylindrical tubes.

[0051] **FIG. 5***b* illustrates shims with alternating rows of slots and circular apertures that could be stacked to form alternating rows of cylindrical tubes and rectangular slots.

[0052] **FIG. 5***c* illustrates a shim having a circular aperture surrounded by conformal semi-circles that could be stacked to form a cylindrical tube adjacent to conformal hemispherical passages.

[0053] **FIGS. 6***a-b* illustrates condensation in a curved and straight channel of equal diameter.

[0054] **FIG. 6***c* illustrates a curved microchannel header or footer.

[0055] **FIG. 7***a* is an exploded view of a reactor formed from shims.

[0056] **FIGS. 7***b*-**7***d* are overhead views of shims within the reactor illustrated in **FIG. 7***a*.

[0057] **FIG. 8***a* illustrates 3 shims having a circular aperture each of which is bisected with a fin rotated at different angles. When stacked, the shims form a static mixer.

[0058] **FIG. 8***b* illustrates a block with a cylindrical opening and a spiral-shaped insert that can be placed into the cylindrical opening to form a static mixer.

[0059] **FIG. 9***a* illustrates an exploded view of a laminated device made of shims having apertures with edge features alternating with shims having smooth edges. Unexploded, overhead views (down a channel) **711** and in cross-section **713**, are also shown.

[0060] **FIG. 9***b* illustrates an exploded view of a laminated device made of adjacent shims having apertures with edge features. Unexploded, overhead views (down a channel) **721** and in cross-section **723**, are also shown.

[0061] **FIG. 9***c* illustrates a vapor bubble formed on top of a surface with edge features.

[0062] **FIG. 10***a* illustrates a vaporizer device.

[0063] **FIG. 10***b* illustrates a shim that can be repeatedly stacked to form a vaporizer body.

[0064] **FIG. 10***c* illustrates shims used to form a header for directing liquid water into a vaporizer body.