# MICROCHANNEL WITH INTERNAL FIN SUPPORT FOR CATALYST OR SORPTION MEDIUM

## TECHNICAL FIELD

[0001] This invention relates to microchannels containing an internal fin for supporting a catalyst or sorption medium. These microchannels are suitable for use in conducting catalytically activated chemical reactions and separating fluids using sorption mediums.

## BACKGROUND OF THE INVENTION

[0002] Microchannel reactors may be used in a variety of catalytic processes wherein reactants contact a catalyst within the microchannel reactor and undergo reaction. The term "microchannel" is used herein to refer to a channel having an internal width or height up to about 10 mm. A problem with these microchannel reactors relates to the fact that for many processes it is difficult to provide adequate catalytic surface area for the process to operate effectively. Also, for many processes it is difficult to provide sufficiently short mass transport distances for the reactants to the catalytic surface area for the process to operate effectively.

[0003] One solution to these problems is to coat the interior walls of the microchannel with an intermediate layer of an inorganic oxide, called a washcoat, in order to provide a high surface area. The catalyst is then deposited on the surface of the washcoat. A problem with the use of these washcoats is that the additional surface area that is provided is not sufficient for many processes.

[0004] Another solution to this problem is to deposit the catalyst on a porous structure such as a foam, felt or wad which is then placed in the microchannel. The term "foam" is used herein to refer to a structure with continuous walls defining pores throughout the structure. The term "felt" is used herein to refer to a structure of fibers with interstitial spaces therebetween. The term "wad" is used herein to refer to a structure of tangled strands, like steel wool. A problem with each of these support structures is that the thermal conductivity provided by these support structures is inadequate for many processes.

[0005] The present invention provides a solution to these problems. With the present invention, one or more internal fins for supporting a catalyst is provided wherein the fin provides enhanced surface area for the catalyst as well as enhanced thermal conductivity. The fins also provide short mass transport distances of the reactant to the catalytic surface where reaction occurs. In one embodiment of the invention, the internal fin provides the microchannel with enhanced structural stability.

[0006] A problem with microchannel reactors that are coupled with adjacent heat exchangers relates to the relatively high pressure drop that often occurs as a result of the small internal dimensions of the microchannels when high heat flux or high throughput is desired. If the microchannel height or width is maintained relatively small to overcome mass transport limitations, the pressure drop tends to increase in inverse proportion to the channel height or width, potentially limiting maximum throughput.

[0007] The present invention provides a solution to this problem by increasing the total cross-sectional area available for fluid flow through the microchannel from the minimum dimension needed to minimize or reduce the effect of mass transport limitations. If the fins project outwardly at right angles from the heat transfer surface from an adjacent heat exchanger, the height of the fins can be significantly greater than the gap size needed to minimize mass transport limitations as long as the spacing between adjacent fins is kept small enough to minimize the mass transport limitations. Taller fins enable lower pressure drop per unit length through the microchannel reactor. The thermal conductivity of the fin material and fin height can also be tailored to prevent heat transfer limitations for the reaction of interest. Since the distances over which the rate of thermal conduction become limiting are often much larger than the distances over which the rate of mass transport become limiting, fin height can often be extended well beyond the maximum gap allowed for the desired mass transport characteristics. Thus a lower pressure drop and/or a higher capacity per microchannel may be realized through the use of the present invention with no decrease in reaction performance.

[0008] The fins provided for herein are not only useful in providing support for catalysts for use within microchannel reactors, they are also useful in providing support for sorption medium for use in separation processes conducted in microchannels.

## SUMMARY OF THE INVENTION

[0009] This invention relates to an apparatus, comprising: at least one process microchannel having a height, width and length, the height being up to about 10 mm, the process microchannel having a base wall extending in one direction along the width of the process microchannel and in another direction along the length of the process microchannel; at least one fin projecting into the process microchannel from the base wall and extending along at least part of the length of the process microchannel; and a catalyst or sorption medium supported by the fin.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In the annexed drawings, like parts and features have like designations.

[0011] **FIG. 1** is a schematic illustration of the inventive apparatus, the apparatus comprising a process microchannel, a fin assembly comprising a plurality of fins positioned within the microchannel, and a heat exchanger adjacent to the process microchannel.

[0012] **FIG. 2** illustrates an alternate embodiment of the apparatus illustrated in **FIG. 1**.

[0013] **FIG. 3** illustrates an alternate embodiment of the fin assembly illustrated in **FIG. 1**.

[0014] **FIG. 4** illustrates an alternate embodiment of one of the fins illustrated in **FIG. 1**.

[0015] **FIG. 5** illustrates another alternate embodiment of one of the fins illustrated in **FIG. 1**.

[0016] **FIGS. 6-10** illustrate alternate embodiments of the fin assembly illustrated in **FIG. 1**.

[0017] **FIG. 11** illustrates a plurality of fins formed in the base wall of the process microchannel illustrated in **FIG. 1**.