achieved when increasing the flow rates or Re number at least for the range of Re number considered for this work.

These results are typical for active surface feature patterns that contain more than one angle across the width of any microchannel wall and where substantially similar surface features are repeated for more than 15 features, especially when using a cis orientation on opposing walls. For patterns with only one angle across the width of the microchannel, the fraction of residence time spent within the features is not necessarily improved as the Reynolds number increases.

What is claimed:

1. Microchannel apparatus, comprising:

a microchannel comprising surface features;

at least a segment of the microchannel characterized by a feature entrance length of more than 10;

wherein the segment is at least 1 cm long;

wherein said segment comprises plural similar, repeating surface features; and

wherein the similar, repeating surface features comprise at least 1 angle in each similar surface feature.

2. The microchannel apparatus of claim **1** wherein the microchannel comprises a circumference and wherein the repeating surface features occupy a majority of the circumference.

3. A method of chemical processing, comprising: flowing a fluid into the apparatus of claim **1** and through the microchannel; and performing a unit operation on the fluid in the microchannel.

4. The microchannel apparatus of claim **1** wherein the microchannel has two, major opposing walls comprising surface features, wherein the surface features have a depth, wherein the distance between two major opposing walls defines the channel gap; and

wherein the ratio surface feature depth:channel gap is greater than 0.3.

5. A method of chemical processing, comprising: flowing a fluid into the apparatus of claim **4** and through the microchannel; and performing a unit operation on the fluid in the microchannel.

6. The microchannel apparatus of claim **4** wherein at least 80% of the perimeter of one surface feature (the perimeter being the interface between the surface feature and the main channel) can be superimposed within the perimeter of a second surface feature by translation along the length in the direction of bulk flow in the main channel, with less than 20 degrees (or, more preferably, without) rotation of either feature perimeter, and at least 80% of the perimeter of the other feature can be superimposed within the perimeter of the one feature by translation along the length in the direction of bulk flow in the main channel, with less than 20 degrees (or, more preferably, without) rotation of either feature perimeter.

7. The microchannel apparatus of claim **4** wherein at least 80% of the perimeter of one surface feature (the perimeter being the interface between the surface feature and the main channel) can be superimposed within the perimeter of a second surface feature by translation along the length in the direction of bulk flow in the main channel, without rotation of either feature perimeter, and at least 80% of the perimeter of the other feature can be superimposed within the perimeter of the one feature by translation along the length in the direction of bulk flow in the main channel, without rotation of either feature perimeter.

8. The microchannel apparatus of claim **1** wherein said plural similar, repeating surface features comprise more than 15 similar, repeating surface features.

9. The microchannel apparatus of claim **4** wherein the surface features on the two major opposing walls are substantially "cis" in orientation relative to each other.

10. The microchannel apparatus of claim **4** wherein the aspect ratio of the surface feature run width to channel gap is in the range of 0.5 to 1.

11. The microchannel apparatus of claim **1** wherein the surface features comprise a catalyst coating.

12. The microchannel apparatus of claim **1** wherein the surface features in said segment comprise more than one angle.

13. The microchannel apparatus of claim **4** wherein the surface features have a depth that is more than 100% of the channel gap.

14. The microchannel apparatus of claim **1** wherein, in the similar surface features, at least 80% of the perimeter of one feature can be superimposed within the perimeter of an adjacent feature without rotation by translation along the length of the microchannel.

15. The microchannel apparatus of claim **4** wherein one major wall comprises surface features having a chevron or check mark pattern, and further wherein surface features on the other major opposing wall comprises a similar array of surface features aligned at the same angle or at an inverted angle.

16. The microchannel apparatus of claim **1** wherein the microchannel has a generally square or rectangular cross-section.

17. The microchannel apparatus of claim **16** comprising surface features on three or more surfaces of the microchannel.

18. The microchannel apparatus of claim **1** comprising a parallel array of planar microchannels connected to a manifold and further comprising surface features within the manifold.

19. The microchannel apparatus of claim **1** comprising surface features in two layers stacked on top of each other wherein the pattern in the two layers is different.

20. The microchannel apparatus of claim **1** further comprising surface features having variable patterns and variable depths.

21. The microchannel apparatus of claim **1** wherein the surface features have a lateral spread ratio in the range of 5 to 20.

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