



(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2004/026223 A1**

**Strook et al.**

(43) **Pub. Date: Dec. 30, 2004**

(54) **LAMINAR MIXING APPARATUS AND METHODS**

**Publication Classification**

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(51) **Int. Cl.<sup>7</sup> .....** **B01D 11/00**  
(52) **U.S. Cl. ....** **210/634; 137/833; 422/101; 210/511; 436/178**

(57) **ABSTRACT**

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A mixing apparatus is used to effect mixing between one or more fluid streams. The mixing apparatus generally functions by creating a transverse flow component in the fluid flowing within a channel without the use of moving mixing elements. The transverse or helical flow component of the flowing fluid or fluids can be created by weak modulations of the shape of the walls of the channel. Transverse or helical flow component can be created by grooves features defined on the channel wall. Specifically, the present invention can be used in laminarly flowing fluids. The mixing apparatus and methods thereof can effect mixing of a fluid or fluids flowing with a Reynolds number of less than about 100. Thus, the present invention can be used to mix a fluid flowing in the micro-regime. The mixing apparatus can be used to mix a fluid in a microfluidic system to significantly reduce the Taylor dispersion along the principal direction. The mixing apparatus can be used to increase the effective exposed area to promote diffusion of components between or within the fluid or fluids.

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(21) Appl. No.: **10/766,108**

(22) Filed: **Jan. 27, 2004**

**Related U.S. Application Data**

(63) Continuation of application No. PCT/US02/23462, filed on Jul. 24, 2002.

(60) Provisional application No. 60/308,206, filed on Jul. 27, 2001.

