Modeling of a Three Inputs Two-Dimensional Geometry Microreactor

E. Robalinho[1], E. Cekinski[2]

[1]IPEN/CNEN-SP, São Paulo, SP, Brazil; Universidade Nove de Julho - UNINOVE, São Paulo, SP, Brazil.

[2]Instituto Mauá de Tecnologia IMT, São Paulo, Brazil; IPT-SP, São Paulo, SP, Brazil.

Abstract

This paper presents the results of modeling of a microreactor with three inputs geometry (or crow's-feet), in relation to distributions of velocities and concentrations. The objective of this work is the study of this kind of geometry with relation to fluid dynamics behavior, improving the knowledge of microfluidics and microreactors projects. The computational system used was a Intel Zeon Quad Core with 16 GB RAM, and COMSOL Multiphysics® software with Chemical Reaction Engineering Module and CFD Module. The calculus domain contains a main channel with a length of 30 mm and three entries, which have the boundary conditions given by: inlet velocities and zero pressure at outlet (laminar flow), ethanol concentration in central channel inlet, water concentration in lateral channels inlets. The discretization of domain was performed using COMSOL routines, in total of 27,956 triangular bidimensional elements. The adopted flow values of ethanol and water (Ve and Va) were discussed and determined a priori with the staff responsible for building the microreactor. Seven transversal lines of concentration values of mixture, located in the main channel, are shown in Figure 1. The concentrations along the main channel are observed in Figure 2. The velocities and concentrations in the initial part of the main channel, for the same simulation, are shown in Figures 3 and 4. These numerical responses allow conclusions about the behavior of the mixture, in particular how fast it becomes homogeneous and therefore how smaller the required length of the main channel (in this case approximately 3 mm). This factor is important for the construction of the device on ceramic, since the optimization of the geometry means lower production costs of the microreactor.

Reference

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Figures used in the abstract

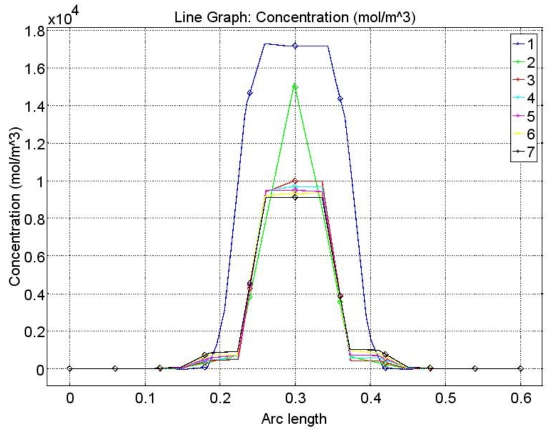

Figure 1: Concentrations measures at seven transversal lines located in the main channel, x=7; 12; 17; 22; 27 (mm).

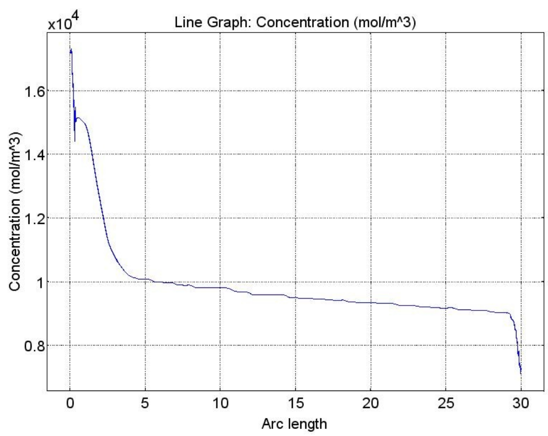

Figure 2: Concentrations along the main channel.

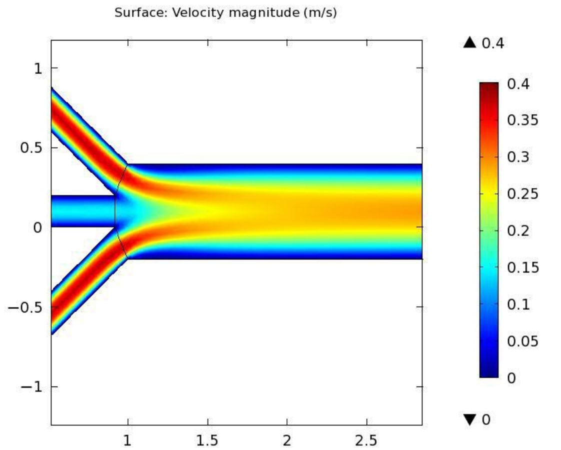

Figure 3: Velocity distribution in the initial part of the main channel.

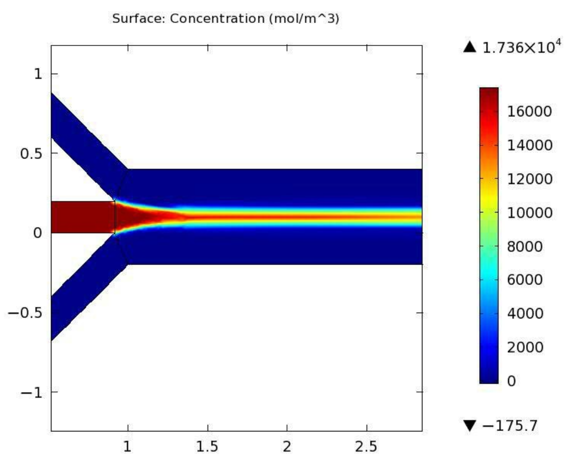

Figure 4: Concentration distribution in the initial part of the main channel.