Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Taylor-Aris Dispersion in Retentive, Ordered Pillar Array Columns[1] XIAOHONG YAN, University of Pennsylvania and Xi'an Jiaotong University, QIUWANG WANG, Xi'an Jiaotong University, HAIM BAU, University of Pennsylvania — The method of volume averaging is applied to estimate the dispersion coefficient of solute advected in ordered pillar array columns with wall retention of the type used in chromatographic separation. The mass transfer resistance of the stationary phase is accounted for. The appropriate closure equations are solved in a unit cell to obtain the dispersion tensor as a function of the Peclet number, pillar pattern and size, and solute properties. The contributions of the flow and the wall adsorption to the dispersion are identified and discussed. The model is verified by comparing its predictions and obtaining favorable agreement with the results of direct numerical simulations and with available experimental data for columns containing pillars. The model is then used to optimize the pillars' shape and pattern to minimize longitudinal dispersion. It is demonstrated that by judicious selection of the pillars' shape and pattern, one can achieve significant reduction in the longitudinal dispersion coefficient.

[1]The work is supported by NSF STTR grant #0822723 to Vegrandis (HHB), China State Scholarship Fund (XY), and National Natural Science Foundation of China grant # 50806056 (QW).

Haim Bau
University of Pennsylvania

Date submitted: 31 Jul 2009 Electronic form version 1.4