Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Direct Numerical Simulation of Turbulent Mass Transfer around a Rotating Circular Cylinder[1] JONG-YEON HWANG, KYUNG-SOO YANG, Dept. of Mech. Engineering, Inha Univ., Incheon, 402-020, Korea, KLAUS BREMHORST, Dept. of Mech. Engineering, The Univ. of Queensland, Brisbane, Qld 4072, Australia, SUNGSU LEE, Dept. of Structural Systems & CAE, Chungbuk National Univ., Cheongju, 361-763, Korea — Characteristics of turbulent mass transfer around a rotating circular cylinder are investigated by Direct Numerical Simulation for Schmidt numbers Sc=1 and 1670. The concentration field is computed for three different cases of low Reynolds number, Re=161, 348 and 623, based on the cylinder radius and friction velocity for Sc=1670. Results confirm that the thickness of Nernst diffusion layer is very thin compared with that of viscous sub-layer in the case of high Sc mass transfer. Visualization of instantaneous concentration reveals that the length scale of concentration fluctuation typically decreases as Reynolds number increases. Reynolds analogy identified at Sc=1 causes a strong correlation between concentration fluctuation and streamwise velocity fluctuation but this is not the case at Sc=1670. For Sc=1670, small positive values of concentration fluctuations are frequently observed particularly outside of the Nernst diffusion layer but inside of the viscous sublayer, while negative values occur less often, but with large magnitude.

[1]This work was supported by Korea Research Foundation Grant (KRF-2004-042-D00026).

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Date submitted: 12 Jul 2005 Electronic form version 1.4