

## 6 - 15 CFD Analysis of Fe Transfer on Roughened Wall Caused by Turbulent Lead-bismuth Eutectic Flow

Chen Xiaolin<sup>1</sup> and Wan Tao<sup>1,2,3</sup>

<sup>1</sup>Advanced Energy Science and Technology Guangdong Laboratory, Huizhou 516000, Guangdong, China;

<sup>2</sup>Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou 730000, China;

<sup>3</sup>School of Nuclear Science and Technology, University of Chinese Academy of Sciences, Beijing 101408, China)

To better understand the stainless steel corrosion behavior in lead-bismuth eutectic flow, the iron mass transfer phenomenon on roughened walls under various pipe flow conditions were numerically investigated. Low Reynolds number  $k-\epsilon$  model was applied in CFD simulation of mass transfer, in which the Reynolds number covers from  $5 \times 10^3$  to  $1 \times 10^5$ , and the roughness widths ( $w$ ) ranges from 50 to 500  $\mu\text{m}$  with periodic ratios ( $\lambda/d$ ) of 2 and 4, respectively. The constant iron concentration was imposed at walls due to the established dissolution equilibrium. Based on the calculated near-wall iron concentration, the averaged mass transfer coefficient  $K_r$  on the periodic length was determined. Subsequently, the Sherwood number was proposed for iron mass transfer on roughened walls in LBE flowing conditions, as presented in the left panel in Fig. 1. The mass transfer enhanced by wall roughness was characterized by the ratio of rough-to-smooth mass transfer coefficient, which depends on dimensionless roughness number, Reynolds number and geometric characteristic (in the right panel of Fig. 1). The detailed discussion of the mass transfer behaviors, referred to the published paper<sup>[1]</sup>. The method and results obtained in this study could provide some values for the future numerical investigations on steel corrosion in lead-bismuth eutectic.

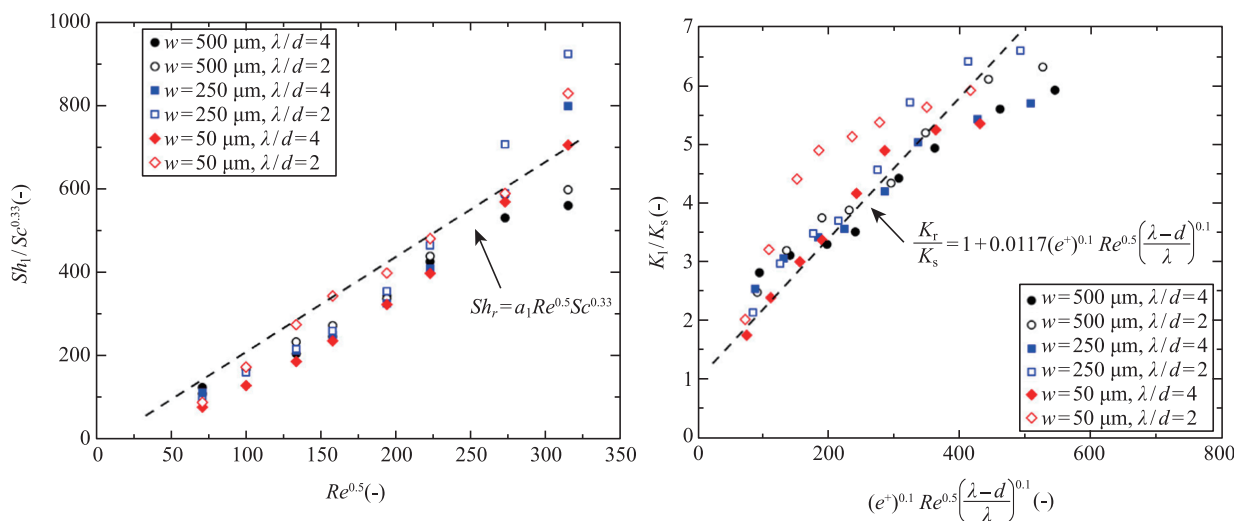


Fig. 1 (color online) The left panel shows the Sherwood number for roughened walls, and  $Sh_r$  are correlated with Schmidt number  $Sc$  and Reynolds number  $Re$ . In the right panel, the ratio of rough-to-smooth mass transfer coefficient  $K_r/K_s$  is correlated with dimensionless roughness number  $e^+$ , Reynolds number and geometric characteristic.

### Reference

[1] X. Chen, T. Wan, *Frontiers in Energy Research*, 10(2022)1005171.