S16-02

Efficient computation of ultraviolet radiation from bow shock waves

Yuhuai Zhang, Tian Wan, Jianzheng Jiang, Jing Fan

State Key Laboratory of High Temperature Gasdynamics, Institute of Mechanics, Chinese Academy of Sciences, 100190 Beijing, China

Ultraviolet (UV) emissions radiated by nitric oxide (NO) and hydroxyl radical (OH) in the bow shock experiment [1] are computed using the direct simulation Monte Carlo (DSMC) method and the Navier–Stokes equations, respectively. Compared to previous studies [2, 3], the trace species separation (TSS) algorithm [4] is adopted for DSMC to accurately and efficiently calculate NO and OH with very low concentration in comparison with the primary species of upcoming air flows. In addition, an estimation of photon mean free path reveals that for the bow shock experiment the optical-thin assumption is valid. Under the assumption, the self-absorption of the hypersonic flow field is negligible, and the ultraviolet emission received by the sensors in the flight test becomes quite easy to calculate. With the aid of the two means briefly described above, the UV emissions of NO and OH can be computed efficiently. More details including comparison with the measured data reported in Ref. [1] will be provided in the full paper.

References

1. Erdman P W, Zipf E C, Espy P, et al. *J. Thermophy. & Heat Trans.*, **8**: 441–446 (1994)
2. Kossi K K, Boyd I D. *J. Spacecraft & Rockets*, **35**: 653–659 (1998)
3. Levin D A, Laux C, Kruger C. *J. Quant. Spectrosc. Radiat. Transfer*, **61**: 377–392 (1999)
4. Fan J, Zhang Y H, Jiang J Z. CSTAM 2012-B03-0174 (2012)