



Planetesimal Bow Shocks: Effects of H₂ Dissociation and Recombination

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Chondrules are mm-sized particles included in many meteorites. There are evidences that they have experienced heating and melting, but the detail of the heating event is still unknown. One of the ideas for heating mechanism is the shock wave heating model. Based on this idea, Ciesla et al. (2004) and Nakajima et al. (2012, in preparation) conducted numerical simulations of planetesimal bow shocks and examined them as a chondrule formation site. They assumed that the gas consists of hydrogen molecules and the gas changes adiabatically; the effects of H₂ dissociation and recombination were ignored. However, the calculated temperature behind the shock front was 4000K or more (Nakajima et al. 2012, in preparation), so H₂ dissociation is expected to occur. Once the dissociation of H₂ takes place, the resultant temperature of the gas would be different. Thus, to understand bow shocks around planetesimals, the gas flow should be investigated with H₂ dissociation/recombination.

We conduct numerical hydrodynamics simulation with H₂ dissociation and recombination around planetesimals. We develop an equilibrium calculation code of H₂ dissociation/recombination and add it to the ZEUS-2D code.

Our simulation results show that the gas temperature is lower and the density is higher in front of planetesimals than the results by adiabatic calculations. This can be understood as a result of the H₂ dissociation. Moreover, in the region where the recombination occurs, the temperature is higher than the one of adiabatic calculation. Also the positions and the durations of the shock fronts are slightly different between both calculation results.

These results suggest that the H₂ dissociation and recombination may affect the heating of chondrule precursors. Precursor dust particles are heated due to the gas drag, which is susceptible to the gas density. So, the thermal history of dust particles under the effect of H₂ dissociation/recombination should be investigated in the future.