NUMERICAL ANALYSIS FOR ARGON ARC PLASMA JET FLOW BY THREE-DIMENSIONAL THERMAL LATTICE BOLTZMANN MODEL

Ju-Song Kim, Yong-Jun Kim, Kyong-Nam Pae, Kwang-Il Ro

A lattice Boltzmann model was developed to simulate numerically thermal fluid flow in a three-dimensional arc torch. It was assumed that argon plasma was in local thermodynamic equilibrium, and influenced by the Lorenz force and the Joule heating. The forced scheme was employed for both flow and temperature fields and the micro boundary on curved walls were considered. Numerical performance of the lattice Boltzmann model in non-transferred arc was validated through comparing with results by finite volume method.

Keywords: non-transferred arc torch, local thermodynamic equilibrium, lattice Boltzmann model.

Introduction. Plasma is a substance in forth state, which have unique nature distinguished from solid, liquid and gas, so it has widely been applied in various fields of industry. In special, due to the requirements low relatively, thermal plasma torches using arc discharge have been in wide application during decades. Most plasma torches operate in direct current (DC), and have three main components: the cathode, the anode and the working gas injection stage. However, the simplicity of torch structure makes a sharp contrast with the complication in thermal, electrical, optical and chemical behaviors from arc plasmas. Therefore, the inexpensive modeling for arc plasma is significant in magnifying application of thermal plasma.

Поступила в редакцию 10 января 2022 г.
После доработки 25 мая 2023 г.
Принята к публикации 26 мая 2023 г.

Faculty of Physical Engineering, Kim Chaek University of Technology, Pyongyang, Democratic People's Republic of Korea; e-mail: pgn84820@star-co.net.kp.