
Investigation of Characteristics of Multiphase AC Arc by High-speed Visualization

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Thermal plasma is expected to be applied in various industrial fields due to its unique advantages such as high temperature, high enthalpy, and rapid quenching capability. Especially, a multiphase AC arc is expected as a promising heat source for mass producing functional materials because it possesses many advantages such as high energy efficiency, large plasma volume, easy to scale-up, and low equipment cost. However, the temperature characteristics and the electrode phenomena in the multiphase AC arc have not been understood because of the difficulties of temperature measurement due to their rapid fluctuation in millisecond timescale as well as the axisymmetric spatial characteristics. To understand and control the fluctuation phenomena is very important to realize this method as industrial technology. Temperature distribution of a multiphase AC arc were investigated using two-color pyrometry. An innovative measurement system combining a high-speed videocamera and band-pass filters was constructed to visualize the temperature of the multiphase AC arc. Temperature distributions with different phase number were successfully investigated. The temperature near the electrode was more than 10,000 K, while that near the center region was about 6,000 K. The highest temperature region increases with the phase number. Electrode temperature and phenomena were observed. The temperature at the electrode tip was about 4,800 K, higher than the melting point of tungsten electrode. Vapor from high temperature electrode was successfully observed.