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# 多相交流アークにおける Li 原子の励起光を用いた金属蒸気の高速度観測

# High-Speed Observation of Metal Vapor Using Excitation Emission of Li Atoms in Multiphase AC Arc


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1. Introduction

A multiphase AC arc has higher energy efficiency, larger plasma volume, and slower velocity compared with conventional thermal plasmas such as DC arc. The multiphase AC arc is expected to be applied to mass production process of nanomaterials. In spite of a large number of experimental and numerical efforts [1], nanoparticle formation mechanism in thermal plasmas has been insufficiently understood. The purpose of this study is to visualize the behavior of metal vapor in the reaction field and measure the temperature for elucidating the nanoparticle formation mechanism.

2. Experimental setup

A schematic diagram of the experimental setup is shown in **Fig. 1(a)**. The multiphase AC arc was generated among 6 electrodes by applying sinusoidal voltages with different phases to multiple electrodes. Driving frequency was changed in the range from 60 to 140 Hz. Micron-scale powder of $Li_2Si_2O_5$ was injected into the multiphase arc at 0.2 g/min.

**Figure 1(b)** shows a schematic diagram of the measurement system. Two band-pass filters at 610 and 671 nm were combined with a high-speed camera for visualization of Li vapor. Excitation temperature of atomic Li was then estimated from the relative intensity ratio method.

3. Results and discussion

**Figure 2** shows high-speed images and temperature distributions. The excitation temperature of Li at the center region estimated about 9,000 K from obtained results. Lithium vapor became more concentrated at center region with higher frequency. This is because the plasma region is concentrated in the center of the furnace as frequency increases [2].

4. Conclusion

Visualization of metal vapor in the multiphase AC arc and temperature measurement of metal vapors were conducted. The obtained findings enable to elucidate the nanoparticle formation mechanism.

**References**


[1] M. Shigeta and A. B. Murphy., J. Phys. D: Appl. Phys., **44**, 17, 174025

[2] T. Okuma, et al., IEEE Trans. Plasma Sci., **47**(1), 32-38 (2019).


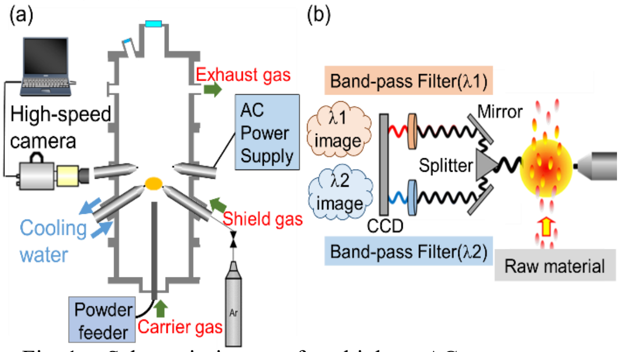


Fig. 1　Schematic image of multiphase AC arc generator (a) and high-speed observation system (b).

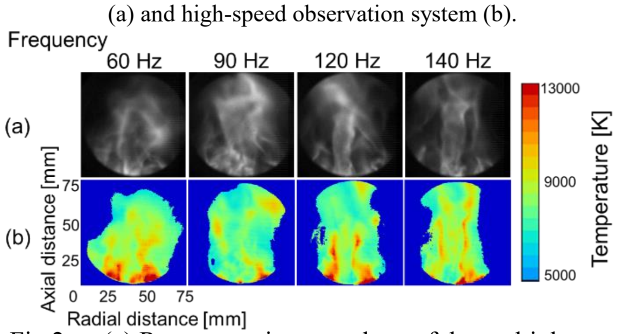


Fig.2　(a) Representative snapshots of the multiphase AC arc and (b) corresponding temperature distributions at different frequencies.