

Modeling of an argon cascaded arc plasma by ANSYS FLUENT

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Synopsis In this work, an argon cascaded arc plasma is simulated by the business software ANSYS FLUENT. In fact, this plasma is a high temperature arc (plasma window) with an average temperature of 12000 °C, which can be used as a medium between high pressure and vacuum mainly due to its characteristics of high temperature. According to the simulating results, the temperature can reach as high as 11500 °C which is in great agreement with that of other reports about plasma window.

Argon cascade arc discharge plasma [1-4] has been widely used as a vacuum-atmosphere interface. It can be used in the field of electron beam melting, nonvacuum electron beam welding and nonvacuum ion material modification.

In recent years, accelerator driven system, ADS [5] is developed to be as a potential novel energy source system. Here, high energy proton beam should be transported from the vacuum cavity of accelerator to the higher pressure region of target region. Moreover, the windowless target system mentioned above has a more promising application comparing to target system with an actual solid window (beryllium or SiN in few cases). And, the most advantage of windowless system is immune to window heating and degradation radiation. Thus, it is necessary to pay more attention to the study of windowless system. Besides, argon cascade arc discharge plasma system (plasma window) is a promising windowless system.

As it is reported, the diameter of plasma channel is 2.36 mm in general. However, in the long run, it is necessary to develop plasma channel with larger diameter (order of cm) to meet the needs of ADS system. Naturally, it needs more harsh process conditions to support high temperature plasma channel with a higher diameter. Thus, simulation for this special argon cascaded arc plasma is necessary before experiment due to the low cost. In this study, ANSYS FLUENT is used to model this plasma arc from the macroscopic angle. The length and diameter of our plasma channel is 6 cm and 3 mm respectively. As it is known, for plasma

window, the most important effect for the role of separation between vacuum and atmosphere is the high temperature. Thus, the temperature distribution for the axis of our plasma channel is illustrated in Fig 1. It can be seen that the temperature of our plasma channel can reach as high as 11500 °C, which is in great agreement with other reports about this special arc plasma.

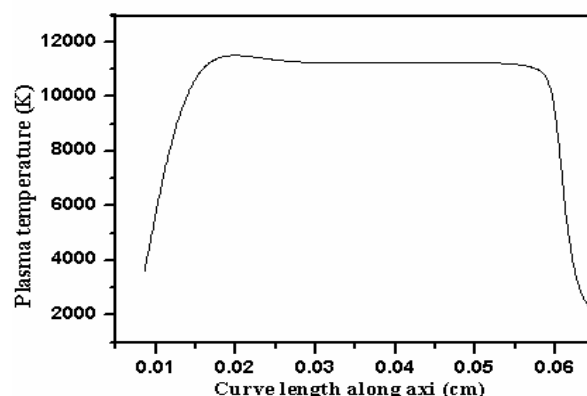


Fig 1. Function of plasma temperature versus the length of plasma channel along the axis.

The detailed about the present work will be presented at the conference.

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