Characteristics of Plasma in Electrical Explosion of Aluminum Wire

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Electrical Explosion of thin metal wire has many important applications such as wire array load in Z-pinch, synthesis of nanometer powder, generation of shock wave, et al. The explosion plasma has crucial significance in these applications ¹,². Plasma characteristics of the explosion plasma is a powerful method to study basic process of electrical explosion of wire. In this paper, the explosion plasma has been experimentally studied with a RLC discharge circuit under variant ambient gas pressure while the plasma temperature and density is determined by plasma radiation spectrum ranged from near UV to visible wavelength. Spatial distribution of the plasma parameter along the wire is studied through the plasma emission spectrum captured by a spatial resolved spectrograph and images captured by a high speed framing camera (HSFC).

The explosion plasma temporal evolution is discussed based on these diagnostic results. The electron temperature of explosion plasma is less than 1eV and varies with experiment conditions as well as the plasma has significantly different distribution under variant gas pressure. The electron temperature is higher at the early stage of plasma phase and gets lower subsequently. The explosion plasma starts at electrode under gas pressure of hundreds Pascal while it is uniform along the wire in most other circumstance except for high vacuum in which a shockwave exists in the explosion plasma.