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Application of cascade antenna array to diagnose plasma bullets and investigation the velocity of bullets in an argon plasma jet

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Abstract

In this study, a new method for measuring the velocity of plasma bullets, based on receiving and detecting the electrical signal of the bullets using an array of cascading antennas in an argon plasma jet with a tip-ring structure is presented. In this structure, the tip electrode plays the role of igniter of plasma generation and the ring electrode plays the role of controlling the plasma jet. To study the variations in the plasma jet, the ring electrode was located at different distances from the tip electrode and the variations in the velocity of the bullets were measured. The experiments showed that if the two electrodes were 1.5 cm apart, at a distance of 15 cm from the plasma formation site, the velocity of the bullets would be about 140 km/s. If the two electrodes are 3.25 cm apart, the bullets will have a speed of about 120 km/s, and if the two electrodes are 5 cm apart, the bullets will have a speed of about 100 km/s. Examination of the results showed that by increasing the distance between the two electrodes, the velocity of plasma bullets also decreases significantly. The results also showed that by moving away from the plasma formation site in the jet tube, the average velocity of plasma bullets increases. For example, at a distance of 21 cm from it, the average speed of plasma bullets in all three configurations will be about 120 km/s. Finally, by varying the electrical power, we concluded that as the electrical power increases, the speed of the bullets increases. According to the obtained results, by doubling the applied power, it was observed that at a distance of 15 cm from the place of plasma formation, the velocity of the bullets will be about 40 km/s at lower power and about 90 km/s at higher power; These results are obtained if the distance between the two electrodes is 3.25 cm and the initial electrical power is 20 Watts.

Keywords: plasma bullet, electrical signal, argon plasma jet, bullet velocity

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