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Low-temperature atmospheric microwave plasma using two-parallel-wires transmission line resonator

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In recent, atmospheric microwave plasmas (AMP) have attracted much attention as promising plasma sources for industrial applications such as material processing, surface treatment and biomedicine [1]. The plasma sources have advantages: the AMP eliminates the need for a vacuum system and the AMP has a long operational time of the electrodes [2]. However, the AMP has its limitation to treat a large area because it is hard to enlarge the plasma volume at atmospheric pressure using a single plasma device with low power. In this work, a plasma source using a two-parallel-wires transmission line resonator (TPWR) in atmospheric argon is described [3]. The E-field distribution and reflection coefficient of the resonator are calculated by COMSOL Multiphysics software based on finite elements method. Then, the TPWR is fabricated to investigate physical properties such as excitation temperature, electron temperature and rotational temperature. The TPWR-AMP can sustain with low power less than 3 watts. The electron excitation temperature was measured by the Boltzmann plot and the rotational temperature was determined by comparing the measured and simulated spectra of rotational lines of the OH band. The electron density was obtained based on Stark broadening with the measured emission spectra. The characteristics of the TPWR-AMP shows that the device has the potential to be used effectively in industry.

[1] J H Kim et al., Appl. Phys. Lett. 86 (2005)
[2] J Winter et al., Plasma Sources Sci. Technol. 24 (2015)
[3] J Choi et al., Phys. Plasmas 24 093516 (2017)

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