

RELIABILITY EXPERIMENTS OF A HIGH CURRENT DENSITY PHOTOCATHODE FOR HIGH-POWER TERAHERTZ DEVICES

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ABSTRACT

Vacuum electronic devices are widely used in microwave and terahertz practical applications, as they can provide efficient high-power electromagnetic radiation. To generate high-power radiation through strong beam-wave interaction, terahertz vacuum devices demand high current electron beams with sub-mm cross-sections [1]. And, emerging research in high power terahertz source based on planar antenna integrated vacuum diode also requires high current density and ultrafast electron source [2]. It should be understood that the important parameter is current density. The required value for future excitation of terahertz wave radiation is about $100 \text{ A/cm}^2 \sim 1000 \text{ A/cm}^2$ [3]. It was found that photocathodes are capable of delivering high current density electron emission. Besides, their small formation area and planar structure bring much convenience to beam optics and confinement [4].

The aim of this study is to explore the emission repeatability, stability, and uniformity of the multialkali photocathode operating at high current densities. The performance of the photocathode was characterized by measuring the anode current as a function of laser power and interval time. The results show that the current can be well repeated when increasing optical power. The photocurrent density was stable at near 1 A/cm^2 after undergoing a current decay process in the first half an hour. It is also interesting to note that almost all the current curves measuring at different areas of the photocathode have a turning point at the laser power of 800 mW. When the laser power is beyond 800 mW, with the same increase in laser power, the increase of current is at least one time bigger than that measuring below 800 mW. The non-uniformity behaviors may be caused by fabrication technology. In order to further improve the current density of the multialkali photocathode, future work will be focused on the composition analysis and theoretical analysis.

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