REAL-TIME PREVENTION OF SPOTS ON THERMIONIC CATHODES IN HIGH-PRESSURE ARC DISCHARGES*

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Considerable advances have been achieved during the past decade in understanding plasma-cathode interaction in high-pressure arc discharges. In particular, it has been shown[1,2] that the appearance of spots in the cathodic phase of AC operation of high-intensity discharge lamps may be prevented by means of a specially chosen shape of the current wave.

The appearance of spots on thermionic cathodes is a result of instability of temperature distribution in the cathode body which is caused by an increasing dependence of the density of energy flux coming from the plasma on the local temperature of the cathode surface. This instability is not very fast and the time of formation of cathode spots is several tens of microseconds. This is significantly longer than the response time of commercially available microcontrollers, which can be of the order of 1μs. This opens the possibility of automated prevention or at least fast quenching of cathode spots in real time: on having detected (for example, from analysis of temporal variation of arc voltage) the beginning of formation of a cathode spot, the microcontroller should initiate a change of current supplied to the arc in a way to rapidly quench the spot or even not to allow it to develop.

In this work, the above idea is checked on an experimental setup including a COST-529 standard high-intensity discharge lamp[3], voltage-driven power amplifier FM 1295 DCU/I 750 (MedTech Engineering), which functioned as a current source controlled by an arbitrary waveform generator Agilent 33220A, and a microcontroller LPC1768 (NXP). Results of the first experiments have confirmed the possibility for microcontroller to detect the arc voltage pattern characteristic for appearance of a transient cathode spot and to trigger a short drop of arc current which rapidly extinguishes the spot or prevents its appearance altogether.

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