Digital Implementation of Time Correlated Single Photon Counting for Barrier Discharge Diagnosis

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A surface dielectric barrier discharge (SDBD) is a low-current, high-pressure discharge that is initiated in an electrode system with a dielectric along the path of the discharge [1]. SDBD under atmospheric conditions exists in the form of individual microdischarges (MDs). The discharge current is a sequence of weak pulses with an amplitude of about 1–100 mA and a duration of 10–100 ns [2]. The initial stage of the MD development occurs at subnanosecond times. Since the formation of a MD is a stochastic process, the study of the total development time of an individual microdischarge is a nontrivial problem.

In this work, to study the development of SDBD driving by a sinusoidal voltage, a Time-Correlated Single Photon Counting (TCSPC) method [3] with digital post-processing was implemented. It is shown that the resolution obtained with a digital TCSPC is no is no worse than 300 ps with a risetime of a single-electron photodetector response of 15 ns and an oscilloscope sampling rate of 10 GS/s. The selection of pulses after the post-processing stage made it possible to study the multi-pulse DBD mode, obtain spatiotemporal diagrams of the light emission of the MDs, and estimate the propagation velocity of negative and positive MDs [4].

[1] Raizer Y P and E A J 1997 *Gas discharge physics* (Berlin: Springer)
[2] Selivonin I and Moralev I 2021 *Plasma Sources Sci. Technol.* **30** 035005
[3] Hoder T, Cernak M, Hoft H, Gerling T and Brandenburg R 2016 *Proc. Sci.* **240** 008
[4] Selivonin I, Kuvardin S and Moralev I 2023 *Plasma Phys. Rep. (accepted for publication)*