One-Dimensional DBD in Narrow Gap Forming an Extended Microplasma's Strip of 100-200 μm in Width

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Abstract

Well-controlled formation of microplasma on the surface at predefined small area is one of the challenging tasks for surface technology. Novel reactor forming an extended but narrow strip of microplasma at higher pressure is shown schematically in Fig.1a. Characteristics of one-dimensional DBD in extremely narrow (≤200μm) gap between very thin metallic blade (100μm) and plane barrier electrode will be presented in report.

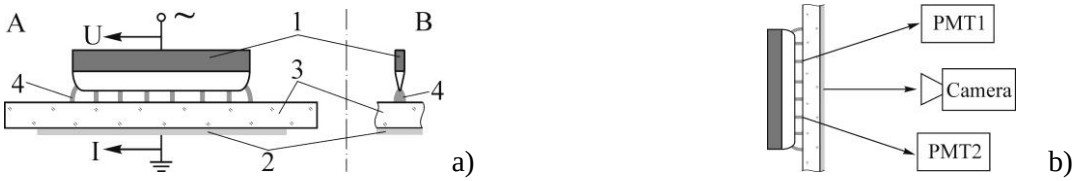

Fig. 1. a) Sketch of electrode design for DBD between thin blade (1) and barrier electrode (3) covered with transparent conductive layer (2); A and B denote the views from two different sides. 4 are microdischarges of DBD. b) Optical scheme.

Typical images (negatives) of a linear DBD in He in narrow gap of 200 μm at different pressures and electric currents are presented in Fig.2. Left column of the pictures in Fig.2 illustrates an evolution of spatial structure of linear DBD at low pressure (P=0.1 atm) with an increase in total discharge current. One can see two things: 1) longitudinal homogeneity of a linear discharge improves if total current increases; 2) microplasma does not occupy a central part of inter-electrode gap because glow discharge exists under subnormal regime when the thickness of a cathode layer exceeds the gap length. The latter feature of a subnormal DBD can be useful in practice if necessary to form some special transverse profile on the surface to be treated.

Right column in Fig.2 shows the change with total current in spatial structure of a linear DBD at higher pressure (P=0.5 atm). In this case, DBD consists of many individual microdischarges (MDs) regularly disposed in central part of inter-electrode gap along the blade. Total number of MDs in narrow gap increases with current up to practically full filling the whole length of the blade. Transverse size of a strip-line formed by reactive microplasma at higher pressure is really small - about 200 μm that is close to the gap length. It is worthy of note that linear DBD in He and N_2 at atmospheric pressure exhibits practically the same behavior with the current.

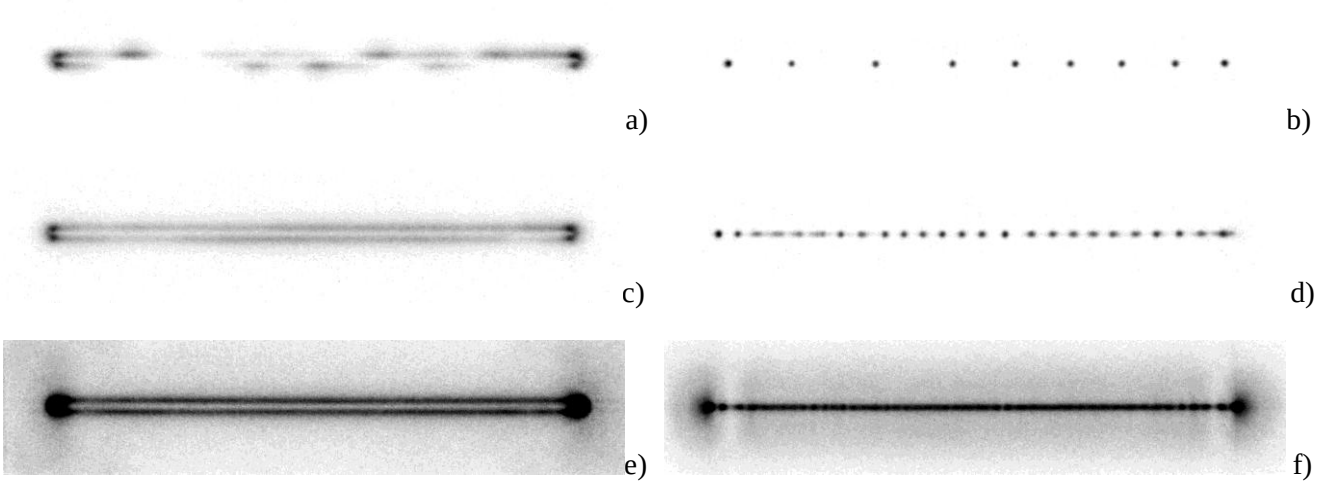

Fig. 2. Images of linear DBD in He in narrow gap at different pressures and currents. Pictures were taken through transparent barrier electrode (see Fig.1b). Gap is 200 μm; length of blade is 37 mm; f=200 kHz. Images a), c), e) and b), d), f) correspond to pressure 0.1 and 0.5 atm respectively; discharge current increases from top image to down one.

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