



## #PLATH00140

SOUR / Plasma sources and electrical discharges

### The DC gas breakdown in tubes of arbitrary length

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#### Abstract content

**The dc gas breakdown in tubes of arbitrary length** V.A. Lisovskiy, E.Ya. Bannikova, S.V. Dudin, R.O. Osmayev, V.D. Yegorenkov V.N. Karazin Kharkiv National University, 4 Svobody Sq., Kharkiv, 61022, Ukraine E-mail: lisovskiy@yahoo.com This paper has investigated the dc discharge breakdown between flat electrodes in a long tube. Two experimental techniques have been employed: 1) the breakdown voltage  $U$  has been measured in the broad range of gas pressure  $p$ , the inter-electrode distance  $L$  being kept fixed; 2) with the gas pressure fixed the breakdown voltage has been measured for different values of the inter-electrode distance. With the first technique we have found that at small inter-electrode distance values ( $L < 5$  cm) the gas breakdown is well described with Paschen's law, i.e. on the  $U(pL)$  graph breakdown curves practically match each other. At larger  $L$  values one observes a shift of breakdown curves to the lower pressure range as well as to the range of higher breakdown voltages. The breakdown curves measured with the first technique possess an important feature that their minima are located on the straight line corresponding to the maximum ionization ability of electrons (Stoletow's constant) and the right-hand branches of all curves approach one another. When one fixes the gas pressure and registers the breakdown voltage  $U(L)$  for different values of the inter-electrode distance  $L$ , then the  $U(L)$  curves possess an U-shaped pattern and with the gas pressure increasing they are displaced down and to the left, with the minimum breakdown voltage of the curves  $U(L)$  decreases. The left-hand branches of the  $U(pL)$  curves measured according to the second technique match for all pressure values because they refer to narrow gap values when Paschen's law holds. But increasing the inter-electrode distance  $L$  leads to the increase of diffusion loss of electrons on the tube walls which area also increases. Therefore the right-hand branches of such breakdown curves at low pressure run in the region of higher breakdown voltage values in contrast to respective branches of the curves obtained according to the first technique. That is, on decreasing the gas pressure the breakdown curves  $U(pL)$  are shifted to the range of higher breakdown voltage values and lesser  $pL$  product values. At the minima of such breakdown curves the ionization ability of electrons is not maximum as a result of a considerable diffusion loss of electrons and non-uniform axial distribution of electric field strength.