On the electrical breakdown of gaseous dielectrics-an engineering approach

Following an examination of the basic gas-discharge concepts, the Townsend breakdown criterion is derived for nonuniform fields and a reformulation of the streamer criterion is undertaken. A direct application of the Townsend criterion to a practical situation is hardly possible, whereas the streamer criterion leads to applicable criteria for the onset of breakdown in air as well as in strongly electronegative gases. In this approach, a knowledge of the relevant ionization coefficients is not required, because these are replaced by parameters obtained from uniform-field Paschen curve data. In addition, the criteria developed do not contain any arbitrary constants. By introducing the electrode surface mean curvature, it is shown that the calculation of breakdown data for widely different electrode shapes can be addressed through a single formula. It is emphasized that the inherent roughness of practical electrode surface demands that caution be exercised in all design criteria.