Small onset voltages in negative corona discharge at the edges of gold and aluminum foils

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In recent years, there has been growing interest in diminishing the power consumption of corona discharge devices, which can be achieved by decreasing the size of the corona electrode. This will result in a reduction of the corona onset voltage and accordingly in diminished power consumption. Decreasing the electrode size can be achieved with various methods, where microfabrication is commonly used for producing sharp tips. However, there are some disadvantages of microfabrication methods such as high cost, limited availability and substantial time requirements. In this context, we propose a low cost method for producing sharp tips.

Gold and aluminum foils can be used as corona discharge electrodes. Foils cut under a small angle have nano-structured sharp edges, which lead to a strong electric field enhancement near the edges. For experiments the triangular-shaped foil was clamped between two plexiglas bricks facing a counter copper-plate electrode. The distance between the foil-tip and the copper plate was set to 5 mm. High voltage was applied to the foil, and the corona current was measured during the voltage increase. The smallest onset voltage for negative corona discharge in ambient air was determined to be 1.2 kV, and in nitrogen below 1.1 kV. This is significantly smaller than the values reported in the literature for sharp tips with similar electrode spacing.

During the corona discharge in nitrogen a strong degradation of the foils due to high currents and, consequently, high thermal load was observed. By contrast, in ambient air only aluminum foils showed degradation and gold foils provided constant performance. Cutting foils allows producing chemically clean edge surfaces, which is a great advantage compared to common microfabrication methods for producing sharp tips, where a chemical modification of the tip material can easily occur. This method is characterized by low cost, low power consumption, ease of application and high availability.