A Development of Atmospheric Pressure Dielectric Barrier-Discharge System Using Computational Tools

B. Turkyilmaz[1], E. Ipek[1], D. Ozdemir[1], E.I. Sungur[1], I.U. Uzun-Kaymak[1]

[1] *Middle East Technical University Department of Physics, Ankara, Turkey*

The Dielectric Barrier Discharge (DBD) plasma systems have a wide range of applicability such as surface sterilization, surface property improvement, ozone generation[1]. In this study the main focus is to simulate and to design an atmospheric DBD system for the purpose of bifurcation studies. Previously, we have shown period doubling bifurcations in dc driven semiconductor-gas discharges[2]. The DBD system consists of two copper ring electrodes placed concentrically around a quartz tube of 4mm inner diameter and 6mm outer diameter. The quartz tube is preferred due to its dielectric characteristics and high melting point. When the Argon gas is fed to the quartz tube at an atmospheric pressure, the plasma is obtained by applying modulated high voltage to one of the electrodes while other one is grounded. Expected uniform microdischarges produce a well defined dielectric discharge behaviour. Applying a high frequency AC high voltage generally reignites the old microdischarge channels at every half period[1]. In order to take advantage of this memory effect, a high voltage high frequency square wave is applied. Spatial and temporal plasma properties are investigated for both 1-D and 3-D models of the system using COMSOL Multiphysics. In agreement with simulations, width and separation of electrodes are determined. It is observed that an order of 10 kV AC high voltage oscillating near 10kHz frequency is at least required effectively to generate the plasma. For plasma generation, a high voltage DC source is modulated using optocouplers and IGBT based H-bridges and transformers. Also, a matching network is designed to optimize the delivered power. Designs of circuits are done using NI Multisim simulations. The current and voltage characteristic of assembled circuits are evaluated with respect to values in simulations.

1. U. Kogelschatz, B. Eliasson, W. Egli .Journal de Physique IV Colloque. **07**, (1997).

2. D. Mansuroglu, I. U. Uzun-Kaymak, I. Rafatov, Phys. of Plasmas, **24**, 053503 (2017).