8th Asia-Pacific Conference on Plasma Physics, 3-8 Nov, 2024 at Malacca
POSTER

Design Optimization of Plasma Systems via COMSOL Multiphysics

S. S. Hussain, M. Bilal Khalid, Saba Shafaq
[1] Department of Physics, Faculty of Sciences, International Islamic University, Pakistan
e-mail (speaker):salman.hussain@iiu.edu.pk

Plasma, a field rich with energetic ions, electrons and active species with a wide range of densities and energies, is capable of being used in a variety of application. The application horizon spans from material processing in physics to dermatology in medical sciences[1]. Surface modifications of materials has benefitted from the plasma nitriding, carburizing and carbonitriding. The techniques used may be of the hot plasma like plasma focus or cold plasma like glow discharges [2,3].

Cathodic Cage-based plasma nitriding (CCPN) is a versatile surface treatment technique used for both metallic as well as non-metallic samples for various applications [1]. Plasma jet, microplasmas, plasma needles are amongst the potential candidates to be used for sensitive surfaces including skin[3]. However, designing a plasma system is a cumbersome task due to the variation in electron density and electron temperatures resulting from varying fields upon altering the design parameters. Different operating parameters like pressure and voltage also play a vital role in determining the plasma characteristics [2].

In this work, a cathodic cage plasma system as well as a plasma jet is optimized for various design parameters via COMSOL Multiphysics. The optimized parameters are used to design a CCPN as well as a Plasma jet to perform surface irradiation of variety of samples.

References
[1]M. Naeem *et al*, Surface and Coatings Technology, 464, 129542.(2023)
[2] G. Murtaza *et al,* Thin solid films 517, 6777(2009),
[3] Cristiane Yumi Koga-Ito *et al,* Plasma Chem and Plasma Process.44,1393 (2024)

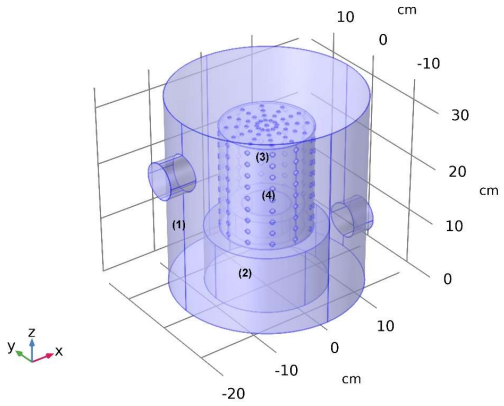

Figure 1. CCPN 3D model used for simulation in COMSOL Multiphysics.

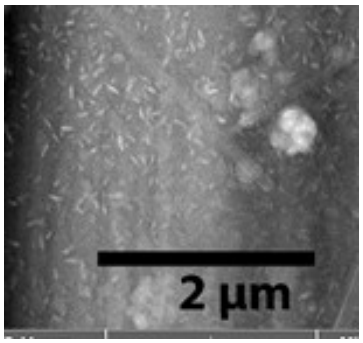

Figure 2. Rice like nanostructures formed by the surface treatment using CCPN system optimized by COMSOL