# Seminar

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# Institute for Plasma Research

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**Title:** Investigation of Dielectric barrier discharge based Cold Plasma Sources for the generation of Reactive oxygen and Nitrogen Species and Vacuum Ultraviolet VUV)/Ultraviolet(UV) Radiation

**Speaker:** Dr. Navin Sharma

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**Date:** 27th September, 2024 (Friday)

**Time:** 10:30 AM

**Venue:** Seminar Hall, IPR

## Abstract

In this talk, we explore cold atmospheric plasma(CAP) and its components that show their therapeutic nature and establishment of a new field of research called “plasma medicine”. I will discuss the different types of CAP sources such as Cold atmospheric pressure plasma jet sources(C-APPJs) and Dielectric barrier discharge(DBD) sources, highlighting available commercial CAP sources, their specifications, and their field of application. I will also present the simulation and experimental analysis of different geometrical configurations of DBD-based C-APPJs. The simulation study of a C-APPJ source having a tapered nozzle structure is carried out using COMSOL Multiphysics software. The simulation model consists of two parts coupled to each other 1) the gas flow model to determine the gas flow dynamics, 2) the gas discharge model to describe the plasma formation and propagation in the C-APPJs. During the experimental investigation, electrical diagnostic, optical emission spectroscopy (OES), and time-resolved imaging have been carried out. Results of the detailed analysis of the discharge formation and generation of plasma plumes using Ar/He alone as working gas, and admixture with a small percentage of $O_2/N_2$ are presented. The dynamic behavior of the plasma plume has been investigated by capturing the Time-integrated images using an ICCD camera which illustrates that the plasma plume comprises different emission layers of definite patterns. OES has been performed to understand plasma chemistry and to identify the reactive species in the C-APPJ sources which shows the generation of metastable, hydroxyl (OH), NO, RONS, electromagnetic fields, UV radiation, etc. The characterization of the developed handheld cold plasma jet source comprising arrangements for admitting the different shielding gases($N_2/O_2$/air) will be discussed. It includes the analysis of the shielding gas effect on the emission spectra and plasma plume. Results on the test of this C-APPJ source for wound healing applications are presented.

In the talk, I also explore the DBD-based $Kr/Cl_2$ and Xenon excimer sources that generate 222 nm Far UV-C and 172 nm VUV radiation, respectively. Details about the mechanism and effective inactivation of Far UV-C radiation, safety features on human tissue, and the characterization of the co-axial configuration of $Kr/Cl_2$ excimer source are to be discussed. The characterization includes the simulation, electrical /optical diagnosis, and absolute power measurement for calculating lamp efficiency. Characterization of the co-axial configuration of the Xenon excimer source is discussed. Characterization includes measurement of V-I characteristics,

spectral characteristics, 172 nm absolute irradiance measurement, total 172 nm radiative power, and corresponding efficiency of the lamp.

A kinetic model developed to investigate the electron beam energy deposition in the Ar gas medium for the generation of EUV radiation is also discussed. The model solves the coupled rate of the equation for the electron density, density of different excited Ar species, Ar ion, and excited Ar ion. The code has been written in MATLAB.

This work has been carried out during my PhD. It has been published in the three reputed SCI journals. Two manuscripts are under preparation and will be communicated soon.