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# Laser-induced plasma deposition of magnesium alloys for surface structuring and thin-film coating: A comparative study with and without Transverse Magnetic Field (TMF)

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This research explores the effect of a 1.1 Tesla Transverse Magnetic Field (TMF) on the Laser-Induced Breakdown Spectroscopy (LIBS) of Mg-alloy plasma. The Mg plasma was generated using an Nd laser (1064 nm, 10 ns) with an intensity of 2 GW/cm². Inert gases such as Ar, Ne, and He were introduced at pressures ranging from 1 to 100 Torr to create the atmospheric environment. The optical emission spectra of the laser-generated plasma were analyzed using a spectrometer, allowing us to calculate the electron temperature (Te) and electron number density (ne). Across all experimental conditions—including varying ambient gases, pressures, and time delays (0.42 s to 9.58 s)—the presence of TMF led to an increase in both Te and ne of the Mg plasma. Plasma confinement by the applied TMF was analytically examined using thermal beta (βt) values, which were consistently found to be 1. The optimal results for Mg-alloy plasma were achieved with ambient Ar in the presence of TMF, while the least favorable outcomes occurred with He gas without TMF. Surface structure analysis of laser-ablated Mg alloy, performed using SEM, revealed distinct patterns: cone formation, cavities, and nonuniform melting in Ar; spike formation and cavity creation in Ne; and conical dendrites and spikes in He. The presence of TMF produced clearly defined structures, contrasting with the more irregular formations observed without the field. By adjusting the Laser-Induced Plasma Parameters (LPP), the surface structure of Mg alloy can be precisely controlled. Optimized and enhanced LPP conditions are highly advantageous for thin-film deposition, multilayer coatings, and ion implantation/doping applications.

## Biography

Asadullah Dawood has completed his PhD at the age of 30 years from Government College University Lahore and University of Waterloo Canada and postdoctoral studies from Advanced Materials Research & Laser Technologies (AMRELAT) Laboratory in the Department of Physics at School of Sciences and Humanities, Nazarbayev University, Nur Sultan Kazaqstan. He is the Head of Physics department of National Excellence Institute (University), Islamabad, a private organization. He has published more than 16 papers in reputed journals.