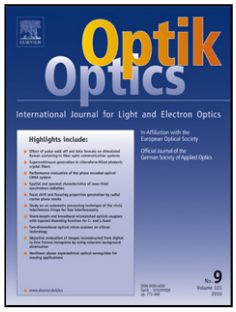

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Spectroscopic and morphological studies of laser ablated silver

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Abstract

The spectroscopic and morphological studies of silver has been investigated after irradiation of Nd:YAG laser by employing Laser Induced Breakdown Spectroscopy (LIBS) and Scanning Electron Microscope (SEM) analyses. Silver targets were exposed to various laser fluences ranging from 5.2 Jcm^{-2} to 41.7 Jcm^{-2} under ambient environment of argon at a pressure of 100 Torr. LIBS analysis revealed that when the laser fluence was increased from 5.2 Jcm^{-2} to 10.4 Jcm^{-2}, an increasing trend for both electron temperature and electron number density of plasma was observed due to enhanced energy deposition. Afterwards, with increasing fluence from 10.4 Jcm^{-2} to 15.6 Jcm^{-2}, a decreasing trend was achieved which was attributed to the shielding effect. With further increase in fluence from 15.6 Jcm^{-2} to a maximum value of 41.7 Jcm^{-2}, a saturation region was achieved and insignificant changes in both plasma parameters were observed. This saturation is explainable on the basis of the formation of a self-regulating regime. SEM analysis revealed the formation of flakes and ridges on the surface of silver at the lowest fluence of 5.2 Jcm^{-2}. For increased fluences ranging from 10.4 Jcm^{-2} to 41.7 Jcm^{-2}, distinct and unorganized melted channels were the dominant features. However, at a maximum fluence of 41.7 Jcm^{-2}, micro and nano crystallites of lamellar (tabular) shape were also formed. At peripheral ablated areas, flakes, cavities, cones and craters with multiple ablated layers were formed. The modifications in surface morphology of laser-ablated silver have been correlated with plasma parameters.

Keywords: Electron number density, electron temperature, laser-induced breakdown spectroscopy, pulsed laser ablation, surface structuring, silver

1. Introduction

Laser ablation is a promising material processing technique. It has been successfully employed for micro and nano structuring of materials, chemical processing, pulsed laser deposition of thin films, generation of nanoparticles and ion sources etc [1-6]. Many groups have reported