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Abstract

We present Stark broadened atomic titanium lines recorded following laser-induced optical break during ablation of a 99.999 % pure titanium sample. The UV lines reveal electron density on the order of 20 to 60 $\times 10^{23}$ m^{-3}, and the electron temperature is estimated to be on the order of 40,000 K some 200 ns after the ablation process. In our study of the modified semi-empirical approach, we conclude that our results favor the standard Gaunt factor without the requirement of introducing an additional effective Gaunt factor, that others appear to use.

Keywords:
Atomic Spectroscopy, Laser-Induced Plasma, Laser-Induced Breakdown Spectrometry, Plasma Diagnostics

1. Introduction

Research involving laser ablation of titanium has long been studied from the perspective of laser-induced breakdown spectroscopy (LIBS)[1] and garners interest for various applications[2, 3, 4, 5, 6]. While the processes involved in the evolution of plasma resulting from laser ablation of a titanium target are generally understood, a more comprehensive and detailed understanding of titanium particles in a laser ablation plume is desired[7]. Of particular importance in this endeavor is the understanding of the plasma environment to which the titanium particles are exposed. A sufficient understanding would include the composition and temporal evolution of the titanium species in the plasma. The analysis of spectral lines emitted from plasma provides a means of quantifying the parameters of the plasma. The current communication investigates various Ti II and Ti III emission lines located between 237 and 245 nm, as observed no later than 500 ns after plasma formation.

Initially, just after plasma formation, spectra gathered from the laser-induced plasma will represent the characteristic spectral continuum provided by the processes (inverse Bremsstahlung, radiative recombination, photoionization) of the many free electrons[8, 9]. Nanoseconds after the laser pulse interacts with the surface and induced-plasma, atomic and ionic lines will become prominent. This occurrence corresponds to the expansion and recombination

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