Numerical investigation of the electron dynamic dependence on gas pressure in the breakdown of hydrogen by KrF laser radiation

By: Gamal, YEED (Gamal, Yosr E. E. -D.)[1,4] ; Elsayed, KA (Elsayed, Khaled A.)[2] ; Mahmoud, MA (Mahmoud, M. A.)[3]

View ResearcherID and ORCID

OPTICS AND LASER TECHNOLOGY
Volume: 44 **Issue:** 7 **Pages:** 2154-2160
DOI: 10.1016/j.optlatec.2012.03.009
Published: OCT 2012
View Journal Impact

Abstract

This paper presents a numerical investigation of the measurements that were carried out by Yagi et al. [12] to study the breakdown of molecular hydrogen induced by short laser of wavelength 248 nm and pulse duration 20 ns. The aim of the study is to give a detailed description of the physical processes which contributed to the breakdown of molecular hydrogen at focused intensities between 4 x 10(12) W/cm(2) and 8.0 x 10(12) W/cm(2) over gas pressure range extended from 150 to 7000 Torr. The applied computer simulation model is based on the numerical solution of the time dependent Boltzmann equation and a set of rate equations that describe the rate of change of the formed excited states population. The experimentally measured rate constants and cross-sections for the various physical processes involved in the model are used in the calculations. Provision is made for the electron impact ionization and photoionization of the excited states. The former process is incorporated parametrically in the calculation owing to the lack of quantitative description of this process. Computations are performed at each gas pressure. The calculated threshold intensities are found to be in good agreement with the experimentally measured ones, both showing a noticeable increase in the higher pressure region. Moreover, calculation of the electron energy distribution function (EEDF) and its parameters demonstrated the exact correlation between gas pressure and the physical processes responsible for determining the breakdown threshold intensity. (c) 2012 Elsevier Ltd. All rights reserved.

Keywords

Author Keywords: Laser induced breakdown; Molecular hydrogen; Time dependent Boltzman equation

KeyWords Plus: MOLECULAR GASES; THRESHOLDS; IONIZATION; IMPACT; H2; EXCITATION

Author Information

Reprint Address: Gamal, YEED (reprint author)

+ King Abdulaziz Univ, Dept Phys, Girls Fac Sci, Jeddah 21413, Saudi Arabia.

Addresses:

+ [1] King Abdulaziz Univ, Dept Phys, Girls Fac Sci, Jeddah 21413, Saudi Arabia
+ [2] Cairo Univ, Fac Sci, Dept Phys, Giza, Egypt
+ [3] Sohag Univ, Fac Sci, Dept Phys, Sohag, Egypt
+ [4] Cairo Univ, Natl Inst Laser Enhanced Sci, El Giza, Egypt

E-mail Addresses: gamaly@yahoo.com

Publisher

ELSEVIER SCI LTD, THE BOULEVARD, LANGFORD LANE, KIDLINGTON, OXFORD OX5 1GB, OXON, ENGLAND

Categories / Classification

Research Areas: Optics; Physics

Web of Science Categories: Optics; Physics, Applied

Document Information

Document Type: Article

Language: English

Accession Number: WOS:000305371800028

ISSN: 0030-3992

Journal Information

Table of Contents: Current Contents Connect
Impact Factor: Journal Citation Reports

Other Information

IDS Number: 960EW

Cited References in Web of Science Core Collection: 26

Times Cited in Web of Science Core Collection: 1