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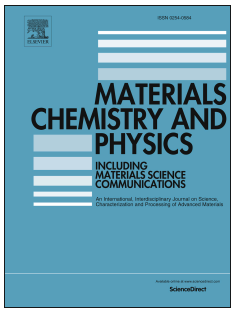

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Comparative study of LIBS and mechanically evaluated hardness of *Graphite/ Rubber* Composites

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Abstract

Graphite is a crystalline form of carbon which has attracted the academic and industrial interest. It has been used as reinforcing filler that can produce highly effective improvement for rubber. This article presents and discusses the development of graphite-based rubber composites and their applications in industries which have been used extensively as reinforcing fillers. Increasing reinforcement of the rubber material leads to an increase in stiffness, modulus, tear strength, cracking resistance, tensile strength, abrasion resistance, and fatigue resistance. Laser-Induced Breakdown Spectroscopy (LIBS) technique has been utilized for determination of hardness and analysis of rubber polymers doped with Graphite filler. Different samples of natural rubber with different graphite filler concentration have been measured. A linear relationship between sample hardness and filler concentration is shown by the conventional hardness measurement techniques and has been demonstrated by LIBS technique too. Other laser-induced plasma parameters such as the electronic density and temperature as a function of time are determined. The same selectivity and ability to excite emission were revealed through measurements using LIBS, and thus the qualitative analysis capability of other techniques was confirmed.

Keywords: Hardness, LIBS, Rubber

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1. Introduction

Natural rubber/ graphite compositions are widely applied in several technological purposes because of their high durability, high elastic deformation, and their capability to be repeatedly strained to high levels without destruction, extrudate distortion or permanent deformation [1]. The mechanical behavior of rubber is affected by various internal and external parameters which produce changes in its chemical and physical composition. In accordance, this will lead to a discrepancy in the mechanical properties of the rubber.

Among the external factors that may cause variations in the physical or chemical behavior are the environmental conditions of time, pressure, temperature and radiation. Chemical structure and composition, the degree of crystallinity besides the size and degree of copolymerization are among the internal factors [2].

Testing mechanical properties of rubber is an area of interest. Numerous parts of tire manufacturer, need specific rubber composites with different mechanical properties to meet these applications. The mechanical properties of natural rubber are refined by graphite filler matrix reinforcement. Developing graphite filler inclusion increases the tensile strength of the composites by sharing the applied load among a group of chains, thus lowering