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HASIL PENILAIAN SEJAWAT SEBIDANG ATAU PEER REVIEW  
KARYA ILMIAH : JURNAL ILMIAH**

Judul Karya Ilmiah (Artikel) : Transversely Excited Atmospheric CO<sub>2</sub> Laser-Induced Plasma Spectroscopy for the Detection of Heavy Metals in Soil

Jumlah Penulis : 4 orang

Status Pengusul : Penulis pertama/ ~~Penulis ke-~~ / ~~Penulis Korespondensi~~ \*\*

Identitas Jurnal Ilmiah : a. Nama Jurnal : Journal of Applied Spectroscopy  
 b. Nomor ISSN : 00219037, 15738647  
 c. Volume, Nomor, Bulan, Tahun : Vol. 84, No. 6, Januari 2018  
 d. Penerbit : Springer US  
 e. DOI artikel (jika ada) : 10.1007/s10812-018-0595-7  
 f. Alamat web jurnal : https://www.springer.com/journal/10812  
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Semarang, 24 Februari 2021

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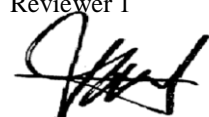
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**LEMBAR  
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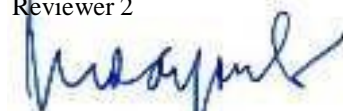
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# Transversely Excited Atmospheric CO<sub>2</sub> Laser-Induced Plasma Spectroscopy for the Detection of Heavy Metals in Soil

 Khumaeni A.<sup>a</sup> , Sugito H.<sup>a</sup>, Setia Budi W.<sup>a</sup>, Yoyo Wardaya A.<sup>a, b</sup>
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**Abstract**

A rapid detection of heavy metals in soil was presented by the metal-assisted gas plasma method using specific characteristics of a pulsed, transversely excited atmospheric (TEA) CO<sub>2</sub> laser. The soil particles were placed in a hole made of acrylic plate. The sample was covered by a to prevent the soil particles from being blown off. The mesh also functioned to initiate a luminous plasma. When a TEA CO<sub>2</sub> laser (1500 mJ, 200 ns) was focused on the soil sample, passing through the metal mesh, some of the laser energy was used to generate the gas plasma on the mesh surface, and the remaining laser energy was employed to ablate the soil particles. The fine, ablated soil particles moved into the gas plasma region to be dissociated and excited. Using this technique, analysis can be made with reduced sample pretreatment, and therefore a rapid analysis can be performed efficiently. The results proved that the signal to noise ratio (S/N) of the emission spectral lines is much better for the case of the present method (mesh method) compared to the case of standard laser-induced breakdown spectroscopy using the pellet method. Rapid detection of heavy metal elements in soil has been successfully carried out. The detection limits of Cu and Hg in soil were estimated to be 3 and 10 mg/kg, respectively. The present method has good potential for rapid and sensitive detection of heavy metals in soil samples. © 2018, Springer Science+Business Media, LLC, part of Springer Nature.

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## Volume 84, issue 6, January 2018

36 articles in this issue

### 1. [Comparison of Degrees of Potential-Energy-Surface Anharmonicity for Complexes and Clusters with Hydrogen Bonds](#)

**Authors (first, second and last of 5)**

- E. N. Kozlovskaya
- I. Yu. Doroshenko
- G. A. Pitsevich
- Content type: OriginalPaper
- Published: 22 January 2018
- Pages: 929 - 938



- Pages: 1081 - 1083

26. [Rapid Determination of Trace Palladium in Active Pharmaceutical Ingredients by Magnetic Solid-Phase Extraction and Flame Atomic Absorption Spectrometry](#)

**Authors (first, second and last of 5)**

- Q. H. Yin
- D. M. Zhu
- Y. L. Yang
- Content type: OriginalPaper
- Published: 22 January 2018
- Pages: 1084 - 1088

27. [Synthesis and Characterization of a Novel Ligand and Spectroscopic Study of the Formation of its Complexes with Different Cations and Their Sensory Characteristics](#)

**Authors**

- M. Shariati-Rad
- M. Karimi
- M. Rezaeivala
- Content type: OriginalPaper
- Published: 22 January 2018
- Pages: 1089 - 1097

28. [Quantum Chemical Calculations of the Spectroscopic Properties and Nonlinear Optical Activity of 2,6-Dibromo-3-Chloro-4-Fluoroaniline](#)

**Authors**

- A. Eşme
- S. G. Sağdıç
- Content type: OriginalPaper
- Published: 23 January 2018
- Pages: 1098 - 1107

29. [Transversely Excited Atmospheric CO<sub>2</sub> Laser-Induced Plasma Spectroscopy for the Detection of Heavy Metals in Soil](#)

**Authors (first, second and last of 4)**

- A. Khumaeni
- H. Sugito
- A. Yoyo Wardaya
- Content type: OriginalPaper
- Published: 23 January 2018
- Pages: 1108 - 1113

30. [Modified Extraction-Free Ion-Pair Methods for the Determination of Flunarizine Dihydrochloride in Bulk Drug, Tablets, and Human Urine](#)

**Authors**

## RAMAN SPECTRA OF GRAPHENE SYNTHESIZED BY CHEMICAL VAPOR DEPOSITION FROM DECANE

M. S. Tivanov,<sup>a</sup> E. A. Kolesov,<sup>a</sup> O. V. Korolik,<sup>a</sup> A. M. Saad,<sup>b</sup>  
N. G. Kovalchuk,<sup>c</sup> I. V. Komissarov,<sup>c</sup> V. A. Labunov,<sup>c</sup>  
M. Opielak,<sup>d</sup> P. Zukowski,<sup>e</sup> and T. N. Koltunowicz<sup>e\*</sup>

UDC535.375.5

*Raman spectroscopy was used to study the structural properties of graphene synthesized by chemical vapor deposition using decane (C<sub>10</sub>H<sub>22</sub>) as a precursor at various hydrogen concentrations. Reduction of the carrier gas flow rate from 150 cm<sup>3</sup>/min to zero changes the average spacing between the defects from 53 to 212 nm and the average grain size from 87 to 798 nm and changes the uniformity and continuity of the graphene layer. The obtained relationships can be used to control the defectiveness, homogeneity, and continuity of the graphene layer of the coating during synthesis by this method.*

*Keywords:* graphene, chemical vapor deposition, decane, Raman spectroscopy, defect.

**Introduction.** The importance of research into graphene arises from its unique characteristics. Graphene is a promising material for various applications on account of its optical transparency, high mechanical strength, and thermal and electric conductivity [1–5]. It is at present being used in the production of field-effect transistors, biosensors, and transparent electrodes.

One of the most widely used methods of synthesis of graphene is chemical vapor deposition (CVD) [6–11]. By CVD it is possible to synthesize large areas of graphene that can then be transferred to other surfaces [12]. The synthesis of graphene with methane (CH<sub>4</sub>) as precursor has been widely represented in the literature. The usual method of CVD synthesis of graphene on a catalyst substrate involves several stages [7] that depend to a significant degree on the type of precursor [11]. By using other hydrocarbons with different molecular mass as precursors it is possible to control the synthesis more effectively on account of change in the kinetics of growth of the graphene [11, 13].

Decane (C<sub>10</sub>H<sub>22</sub>) is a member of the homologous series of alkanes. In the present work the possibility of using it as precursor for the synthesis of graphene was investigated. We draw attention particularly to the following feature of the precursor. Thermal decomposition of decane is accompanied by the formation of \*C<sub>x</sub>H<sub>y</sub> radicals [14], the presence of which in the gas mixture reduces the dissociation energy of the bond in the nitrogen molecule [15, 16]. This leads to a larger concentration of nitrogen atoms in the gas mixture compared with the process that only involves thermal decomposition of the nitrogen molecules (bond energy 226 kcal/mole). This feature makes it possible to dope the graphene with nitrogen during the synthesis processes with decane as precursor and nitrogen as carrier [17]. All this gives rise to the need to study the processes involved in the synthesis of graphene from decane.

Another important reagent in the synthesis of graphene is hydrogen, which is not only used for the reduction of copper oxide on the surface of the catalyst [18] but also has a direct effect on the formation of graphene. During the growth of graphene in the presence of hydrogen the latter is adsorbed on the surface of the copper [19, 20]. The adsorbed hydrogen atoms act as co-catalyst in the decomposition of the hydrocarbon [21], and at low concentrations of hydrocarbon in the absence of H<sub>2</sub> the endothermic decomposition reaction takes places slowly. Moreover, the hydrogen removes surplus layers of graphene from the substrate [21, 22]. At the same time negative effects from the use of hydrogen in the synthesis

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## ACTIVITY, STABILITY, AND STRUCTURE OF NATIVE AND MODIFIED BY WOODWARD REAGENT K MUSHROOM TYROSINASE

S. Emami,<sup>a</sup> H. Piri,<sup>b</sup> and N. Gheibi<sup>b\*</sup>

UDC 535.37:577.15

*Mushroom tyrosinase (MT) was considered a good model for studying the inhibition, activation, and mutation of tyrosinase as the key enzyme of melanogenesis. In the present study, the activity, structure, reduction, and stability of native and modified enzymes were investigated after the modification of MT carboxylic residues by the Woodward reagent K (WRK). The relative activity of the sole enzyme was reduced from 100 to 77.9, 53.8, 39.4, and 26.4% after its modification by 2.5, 5, 25, and 50 ratios of [WRK]/[MT], respectively. The  $T_m$  values were calculated from thermal denaturation curves at 61.2, 60.1, 58.3, 53.9, and 45.5°C for the sole and modified enzymes. The reduction of the  $\Delta G_{H_2O}$  values for the modified enzyme in chemical denaturation indicated instability. A structural study by CD and intrinsic fluorescence technique revealed the fluctuation of the secondary and tertiary structures of MT.*

**Keywords:** modification, mushroom tyrosinase, Woodward reagent K, kinetics, structure.

**Introduction.** Mushroom tyrosinase (E.C. 1.14.18.1), as a polyphenol oxidase, is a multifunctional copper-containing enzyme from the oxidase superfamily. It is widely distributed in microorganisms, plants, and animals [1]. It plays a key role in melanin biosynthesis through the catalysis of two disparate reactions: the hydroxylation of monophenols (cresolase or monophenolase activity) and the oxidation of *o*-diphenols (catecholase or diphenolase activity) into reactive *o*-quinones [2–4]. Modification is a good method to recognize the role of residues in the structure and function of proteins. The polar amino acids, such as glutamate, aspartate, lysine, arginine, histidine, serine, tyrosine, methionine, and tryptophan, can be modified by chemical reagents. The affinity of amino acids for participating in the reactions depends on environmental conditions like pH, the ionic power, the buffer type, and the nucleophilicity features [5]. The amino acid side-chains that participate in the enzymatic activity are usually accessible to the solvent and can be modified by the reagents that are especially accessible to proteins. Sometimes, according to the specific environment of the active site, we can design specific reagents. Chemical modification in the absence and presence of a ligand is a suitable method to recognize the side-chains of the amino acids' active sites [6]. In enzymes, the catalytic amino acid side-chains can be selectively modified by using the suicide substrates, and these can result in enzyme inactivity. The modification of amino acid side-chains plays an important role in an enzyme's catalytic activity [7]. MT has 576 residues, which can be divided into two parts. The residues numbering 1–392 form the chain part, and those numbering 393–576 form the propeptide part, which disappears in the mature form of MT. In the sequence of MT, the residues numbering 61, 85, and 94 are the binding sites of copper I ( $\text{Cu}^{1+}$ ), and those numbering 259, 263, and 296 are the binding sites of copper II ( $\text{Cu}^{2+}$ ). The mature MT includes 52 aspartic acid and glutamic acid residues in its sequence. The residues numbering 47, 50, 269, 273, 289, and 300, which are aspartic acid, and the residues numbering 67, 98, 102, and 256, which are glutamic acid, are located near the histidine residues of the MT active sites [8, 9]. The modification of these carboxyl groups by WRK causes enzymatic inactivation and the partial unfolding of the MT structure, leading to its instability.

Several studies have been done on the amino acid residues to reveal their respective roles in the function of enzymes. The modification of Tyr62 in lysozyme with N-bromosuccinimide caused a decrease in the catalytic velocity ( $K_{\text{cat}}$ ) of the enzyme [10]. In the other investigations, the role of different catalytic groups was considered by the modification of residues e.g., the conversion of  $-\text{SH}$  to  $-\text{OH}$  in cysteine residues in the active site of papain [11], the conversion of  $-\text{OH}$  to  $-\text{SH}$

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