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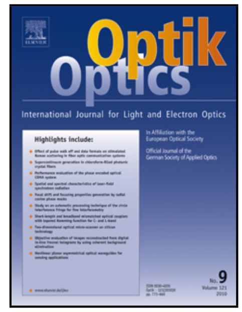

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Organic Vapor Sensor Using Photoluminescence of Laser Ablated Gold Nanoparticles on Porous Silicon

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Abstract

Gold nanoparticles (AuNPs) were prepared by laser ablation technique of gold target submerged in double distilled deionized water (DDDW) at room temperature. AuNPs are incorporated into porous silicon (PS) that was prepared using the electrochemical etching technique. In this study, the influence of gold colloids on PS characteristics has been investigated. The variation of the surface roughness and morphology after noble metal modification was revealed by Atomic Force Microscopy (AFM), while, Fourier Transform Infrared (FTIR) characterization techniques proved the oxidation of porous silicon substrate leading to the passivation of the surface states. It was also observed that the reflectivity was decreased due to the deposition process depending on the size and the quantity of gold colloid solution. These are attributed to metal nanoparticles (MNPs) with narrow particle-size distribution uniformly coated on the surface, thus, the substrate efficiency is strictly related to their dispersion, which could yield to local surface Plasmon (LSP).The photoluminescence (PL) spectroscopy revealed that the intensity is strongly depend on AuNPs deposition and effected by organic vapor after deposition on PS.

***Keyword**:* laser ablation; gold nanoparticles; porous silicon; photoluminescence; organic vapor sensor.

Introduction

Deposition of nobel MNPs on semiconductor nanocrystals (SNCs) have attracted great attention because the phenomenon Surface Plasmon Resonance (SPR) exhibited in MNPs [1]. The properties of PS made it very interesting for research such as simple formation, large surface to volume ratio and photoluminescence efficiency but the surface of PS exhibits spontaneous oxidation in ambient so its surface is needed to be modified to obtain stability to fabricate astable PS based device [2,3]. The addition of AuNPs plays an important role to obtain this stability. In addition, the interaction between AuNPs and PS can have enhanced the spectral features of PS to improve the efficiency of emission involving the charge transfer through AuNPs/PS interface [4]. This interface can made AuNPs by laser ablation technique where laser beam is distinguishable by several features high coherence, high directionality and high energy density that made laser applied in many different field such as synthesis of nobel MNPs [5].

One of the applications of laser is laser ablation of nobel metal plate in liquid to produce MNPs. We can define laser ablation as a physical process (top-down) to prepare nanoparticle by use the short pulses of laser energy focused on metal plate in liquid. The metal plate absorbs the energy and is vaporized the vaporized then condenses as nanoparticle [6]. The properties of this method is simple [7], low-cost [8], do not require vacuum chamber, and very clean reliable for generation the nanoparticles, which are free from contamination [9,10] by reducing agent [11]. The properties of nobel MNPs depend on the size and shape [12] they last influence by the operating condition laser pulse duration (nanosecond, Picosecond and femtosecond), laser fluence (energy per area), laser power, laser wavelength, type of metal, the distance between target and lens of laser and nature of liquid [7,8,13,14].Many nobel MNPs are produced by laser ablation in liquid such as gold (Au), silver (Ag), platinum (Pt) and nickel (Ni) …etc. AuNPs have attracted much attention attributed to unique properties physical and chemical that depends on size and morphology [15]. AuNPs have both chemically and physically stability [16]. The AuNPs