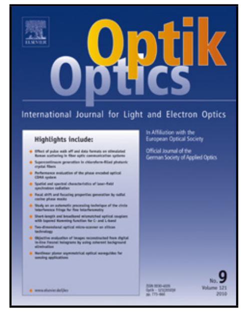

Title: Plasmon resonance-enhanced photocathode by light trapping in periodic concentric circular nanocavities on gold surface

Authors: Sina Foroutan, Hossein Zaki Dizaji, Ali Riahi

PII: S0030-4026(17)30292-9
DOI: http://dx.doi.org/doi:10.1016/j.ijleo.2017.03.033
Reference: IJLEO 58956

To appear in:

Received date: 20-6-2016
Revised date: 7-3-2017
Accepted date: 13-3-2017

Plasmon Resonance-Enhanced Photocathode by Light Trapping in Periodic Concentric Circular Nanocavities on Gold Surface

Sina Foroutan[a,*] sina.foroutan92@ms.tabrizu.ac.ir, Hossein Zaki Dizaji[b], Ali Riahi[b]

aSchool of Emerging-Engineering Technologies, University of Tabriz, Tabriz 5166614761, Iran

bFaculty of Science, Imam Hossein Comprehensive University, Tehran, Iran

[*]**Corresponding author**:

Abstract. In this paper, we report the design and characterization of a new surface plasmon polariton (SPP) nanocavity on the surface of gold film to enhance the efficiency of metallic photocathodes. The plasmonic surface increases absorption over normal metals, and due to the localization of fields, this results in complete elimination of reflection from the metal surface. Here, a periodic array of concentric circular nanocavities on the gold surface was designed to exhibit multiband plasmonic resonances at 600 nm, 710 nm and 800 nm. We theoretically report on the enhancement of relative quantum efficiency from gold cathode up to 70 times compared to a flat surface, by use of nanostructured plasmonic surfaces to trap, localize, and enhance optical fields. The proposed structure have a number of useful practical features such as broadband or multiband absorption and broad angular bandwidth. The symmetry in the proposed structure eliminates any polarization dependence within the structure.
Keywords: Plasmonic; Nanocavity; Efficiency; Polarization; Photocathode.

1. Introduction

Recent progress in nanotechnologies has paved accurate control of the optical characteristics of metal surface by shaping them with sub-wavelength features [1]. At nanostructured surfaces, strong coupling can occur between incident light and the metal collective electron oscillations or surface plasmons (SPs). By tuning the SP properties, controlled by the geometrical dimensions of the nanostructures, it is possible to greatly enhance light absorption or reflection at selected wavelengths and localize the optical field intensity. These phenomena have attracted great interest in research related to laser-material interactions on nanometer femtosecond scales and many applications in, for example, optics, photovoltaic, sensors and subwavelength detection of biomolecules [2-5].

Metals are commonly used as ultrafast photoemitters. In such applications high optical reflectivity is problematic situation. This is especially the case for gold, silver, and aluminum, which are all efficient reflectors. However, by excitation of electrons in the form of a plasmon, it is possible to make these free-electron-like metals perfect absorbers of light. This process is