

The
United
States
of
America



The Director of the United States Patent and Trademark Office

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, or importing into the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.



US00889811B2

(12) **United States Patent**
Jen et al.

(10) **Patent No.:** US 8,898,811 B2
(45) **Date of Patent:** Nov. 25, 2014

(54) **METAL NANOPILLARS FOR SURFACE-ENHANCED RAMAN SPECTROSCOPY (SERS) SUBSTRATE AND METHOD FOR PREPARING SAME**

(58) **Field of Classification Search**
CPC G01Q 70/00; G01Q 70/08; G01Q 70/10; G01Q 70/12; G01Q 70/14; G01Q 70/16
USPC 356/300, 301, 326; 850/8, 9, 52, 56, 57, 850/58, 59; 977/700, 712, 720, 742, 743, 977/846, 876
See application file for complete search history.

(71) Applicant: Yi-Jan Jen, Keelung (TW); Ching-Wei Yu, Taipei (TW)

(56) **References Cited**
U.S. PATENT DOCUMENTS
2011/0245034 A1 * 10/2011 Smith et al. 502749
2013/0050695 A1 * 2/2013 Eriksson et al. 356701

(72) Inventor: Yi-Jan Jen, Keelung (TW); Ching-Wei Yu, Taipei (TW)

OTHER PUBLICATIONS
Chasey et al. "Aligned silver nanorod arrays produce high-sensitivity surface-enhanced Raman spectroscopy substrates", Applied Physics Letters 87, 031904 (2005).*

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

* cited by examiner

(21) Appl. No.: 13/729,078

Primary Examiner—Nicole Ippolito
(74) Attorney Agent, or Firm—McClure, Qualey & Rodack, LLP

(22) Filed: Dec. 28, 2012

(65) **Prior Publication Data**
US 2013/0183540 A1 Jul. 18, 2013

(51) **Int. Cl.**
G01Q 70/16 (2010.01)
G01N 21/65 (2006.01)
B05D 5/06 (2006.01)
C23C 14/14 (2006.01)
C23C 14/22 (2006.01)

(57) **ABSTRACT**
Disclosed herein describes an SERS sensing substrate comprising upright metal nanostructures made by using oblique angle deposition (OAD) collocated with self-rotation substrate, wherein said upright nanostructures include individual upright nanopillars and metal/dielectric multilayered upright nanopillar stacks. The SERS sensing substrate exhibits higher and enhanced adsorption spectra for unpolarized incident rays in the visible and infrared wavelength regimes.

(52) **U.S. Cl.**
CPC G01N 21/658 (2013.01); B05D 5/061 (2013.01); C23C 14/14 (2013.01); C23C 14/226 (2013.01)
USPC 850/58; 850/52; 356/300; 356/301; 356/326

14 Claims, 11 Drawing Sheets

