33

Accession number:20122915258969

Title:THz conductivities of indium-tin-oxide nanowhiskers as a graded-refractive-index structure Authors:Yang, Chan-Shan (1); Chang, Chia-Hua (2); Lin, Mao-Hsiang (1); Yu, Peichen (2); Wada, Osamu (1); Pan, Ci-Ling (1)

Author affiliation:(1) Department of Physics, National Tsing Hua University, Hsinchu, 30013, Taiwan; (2) Department of Photonics, Institute of Electro-Optical Engineering, National Chiao Tung University, Hsinchu, 30010, Taiwan; (3) Center for Collaborative Research and Technology Development, Kobe University, Kobe 657-8501, Japan; (4) Department of Electronics and Electrical Engineering, University of Sheffield, Sheffield S1 3JD, United Kingdom; (5) Frontier Research Center on Fundamental and Applied Science of Matters, National Tsing Hua University, Hsinchu, 30013, Taiwan

Corresponding author: Yang, C.-S.

Source title:Optics Express

Abbreviated source title:Opt. Express

Volume:20

Issue:SUPPL. 4

Issue date:July 2, 2012

Publication year:2012

Pages:A441-A451

Language:English

E-ISSN:10944087

Document type:Journal article (JA)

Publisher:Optical Society of America, 2010 Massachusetts Avenue NW, Washington, DC 20036-1023, United States

Abstract:Indium-tin-oxide (ITO) nanowhiskers with attractive electrical and anti-reflection properties were prepared by the glancing-angle electron-beam evaporation technique. Structural and crystalline properties of such nanostructures were examined by scanning transmission electron microscopy and X-ray diffraction. Their frequency-dependent complex conductivities, refractive indices and absorption coefficients have been characterized with terahertz time-domain spectroscopy (THz-TDS), in which the nanowhiskers were considered as а graded-refractive-index (GRIN) structure instead of the usual thin film model. The electrical properties of ITO GRIN structures are analyzed and fitted well with Drude-Smith model in the 0.2~2.0 THz band. Our results indicate that the ITO nanowhiskers and its bottom layer atop the substrate exhibit longer carrier scattering times than ITO thin films. This signifies that ITO nanowhiskers have an excellent crystallinity with large grain size, consistent with X-ray data. Besides, we show a strong backscattering effect and fully carrier localization in the ITO nanowhiskers. & copy; 2012 Optical Society of America.

Number of references:39

Main heading:Nanowhiskers

Controlled terms:Electric properties - Indium - Refractive index - Thin films - Tin - Transmission electron microscopy - X ray diffraction

Uncontrolled terms: Absorption coefficients - Anti-reflection - Bottom layers - Carrier localization - Carrier scattering - Complex conductivity - Crystalline properties - Crystallinities - Electron

beam evaporation - Frequency-dependent - Indium tin oxide - ITO thin films - Large-grain - Scanning transmission electron microscopy - Terahertz time domain spectroscopy - Thin film model - X ray data

Classification code:933.1.1 Crystal Lattice - 933 Solid State Physics - 761 Nanotechnology - 741.3 Optical Devices and Systems - 741.1 Light/Optics - 714.2 Semiconductor Devices and Integrated Circuits - 701.1 Electricity: Basic Concepts and Phenomena - 549.3 Nonferrous Metals and Alloys excluding Alkali and Alkaline Earth Metals - 546.2 Tin and Alloys

DOI:10.1364/OE.20.00A441

Database:Compendex

Compilation and indexing terms, Copyright 2012 Elsevier Inc.