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Keywords: X-ray, raman, epitaxy

MS28.P09

Acta Cryst. (2011) A**67,** C408

Growth and characterization of p-type ZnO films by Arsenic thermal diffusion

Andraca-Adame J.A.,[a] García-Serrano O.,[b] Vázquez-Agustín M.,[b] Romero-Paredes G.,[b] Martínez Juárez J.,[c] Peña-Sierra R,[b] *[a] Nanoscience and Micro and Nanotechnology Center IPN. U.P.A.L.M. Av. Luis Enrique Erro S7N, Zacatenco. 07738, Mexico D.F. (México). [b] Department of Electrical Engineering, Solid State Electronic Section (SEES), CINVESTAV-IPN, Mexico D.F. Av. IPN 2508, Col. San Pedro Zacatenco 07360 México, D.F. (México). [c] Semiconductor Devices Research Center BUAP. 14 Sur and San Claudio, Ciudad Universitaria, 72570, Puebla, Pueb.* E-mail: jandraca@ipn.mx

ZnO can be used as a UV light emitter and ZnO could be used to excite phosphors to produce white light. ZnO *p-n* junctions was reported with phosphorus doping [1]. However is needed to develop new and easily *p*-doping methods for formation of *p-n* junctions in ZnO. We reported a simple and novel homemade system to obtained ZnO p-type.

ZnO n-type single crystal substrates were obtained from MTI Corporation. The Arsenic doping was introducing through arsenic diffusion mechanism. *p-n* junctions have been formed in single-crystal ZnO substrates by diffusion of As. The properties of ZnO:As films were studied by x-ray diffraction (XRD), X-ray spectroscopy (XPS), Raman scattering and photoluminescence (PL) measurements. Hall-effect measurements were done at room temperature. A decrease on carrier concentration, mobility and resistivity were obtained. The decrease on the electrical values is related to self compensation between native defects and arsenic interstitials. ZnO p-type thin film layer was obtained by simple method with As diffusion on ZnO single crystal.

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Keywords: ZnO, p-n homojuntions, As diffusions

MS28.P10

Acta Cryst. (2011) A**67,** C408

Physical properties of ZnS thin films grown on GaAs by RF magnetron sputtering

Eladio Flores-Mena,[a] Joel Díaz-Reyes,[b] Javier Martínez-Juárez,[c] Arturo Méndez-López,[c] Moisés Gutiérrez-Arias,[a] Monserrat Morín-Castillo,[a] Miguel Galván-Arellano,[d] *[a]Facultad de Ciencias de la Electrónica, BUAP, Puebla, Puebla (México).[b]Centro de Investigación en Biotecnología Aplicada,IPN, Tepetitla, Tlaxcala (México). [c]Centro de Investigaciones en Dispositivos Semiconductores, BUAP, Puebla, Puebla. (México). [d]Depto. Ing. Eléctrica, SEES, CINVESTAV-IPN, México, D.F. (Mexico).* E-mail: eflores@ece.buap.mx

As one of the most important II-VI group semiconductors, zinc sulfide (ZnS) with a wide direct band gap of 3.8 eV has been extensively investigated and used in electroluminescent devices, flat panel displays, infrared windows, sensors, and lasers. To explore the possibility of using it in electroluminescent devices, a study of the structural and optical properties of the host material is an important step. Based on the above criterion, the structural and optical properties of ZnS films have been studied in the present work. ZnS thin films were grown on GaAs (001) substrates at different temperatures by RF magnetron sputtering. The XRD analysis reveals that deposited films below 335 ºC, assumed the zinc blend structure. Samples annealed at temperature above 335 ºC showed mixed phases of the zinc blend and wurzite structures. Information about crystallite size is obtained from (001), (111) and (104) diffraction peaks. The average crystallite size of the film was determined to be w 32 nm using the Scherrer formula. Besisdes it made a experimental and theoretical study on first- and second-order Raman scattering of zinc blende. Based on the calculated phonon band structure, phonon density of states, and symmetry selection rules, one has clearly identified for the first time the origins of these vibration modes in the second-order Raman spectra.

Keywords: II-VII, X-ray, sputtering

MS28.P11

Acta Cryst. (2011) A**67,** C408

Growth of transition metal doped AlN single crystal and its stimulated emission

Wenjun Wang, Liangbao Jiang, Sibin Zuo, Shunchong Wang, Hui li, Kaixing Zhu, Jun Wang, Xiaolong Chen *Research and Development Center for Functional Crystals, Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, P.O.Box 603, Beijing 100190, (China).* E-mail: wjwang@aphy.iphy.ac.cn

Aluminum nitride (AlN) as a wide bad gap semiconductor has attracted increasing attention. Transition metals (TM) doped AlN micro/nano structures also have gained increasing attention for its potential applications in the field of optical and spintronic devices. However, most of the researches are focused on the influence of TM on the magnetism and photoluminescence properties of AlN micro/nano structures. In this work, we report the observation of the stimulated emission of TM doped AlN crystalline whisker.

Transition metal (Fe, Ni) doped AlN crystalline whiskers were grown by PVT method in a RF-heated furnace. Graphite crucible with 32mm in inner-diameter was used as heating element. TaC crucible with 30mm in inner-diameter and 50mm in depth was placed in the graphite crucible as AlN charge container. Under typical growth conditions, the reactor pressure was 0.6atm and the source temperature was maintained at 1700ºC. AlN (99.99%) and Fe or Ni (99.99%) powders were used as reacted sources. The doping concentration of TM was controlled by the mole ratio of TM in the source material. Large scale triangular AlN whiskers were successfully grown. We found that TM has the function to control the morphology of the AlN whisker. The doped AlN whiskers show triangular shape while the undoped AlN whiskers are hexagonal shape. The optical characteristics of the doped AlN whiskers were investigated. Stimulated emission at about 607 nm with the linewidth less than 0.2 nm from single Fe-doped AlN triangular whisker was firstly demonstrated at room temperature. Longer luminescence lifetime of over 2.5ms was observed. Our work demonstrates that AlN single crystal is a new excellent host for solid state laser which might open a door to new high power lasers.

Acknowledgment: This work is supported by The National Basic Research Program of China (973 Program) grant No. 2007CB936300, the National High Technology Research and Development Program of China (863 Program) grant No. 2006AA03A107 and the National Natural Science Foundation of China (grant No. 50702073).

Keywords: AlN, single crystal growth, growth from vapor