STUDY THE OPTOELECTRONIC CHARACTERISTICS AND VAPOR GROWTH OF POLYCRYSTALLINE GAN FILMS

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ABSTRACT

THE FEASIBILITY STUDY OF POLYCRYSTALLINE GAN FILMS DEPOSITED ON AS-CUT POLY-SI SUBSTRATES BY METALORGANIC CHEMICAL VAPOR DEPOSITION (MOCVD) IS THE MAIN WORK IN THIS ARTICLE. FROM THE MEASURED RESULTS IN TERMS OF SURFACE MORPHOLOGY, CRYSTALLINITY, PHOTOLUMINCESENCE (PL), AND OPTOELECTRIC PROPERTIES, THE OPTIMUM GROWTH PARAMETERS AND MECHANISMS OF POLY-GAN CAN BE ESTABLISHED IN THIS STUDY. HEREAFTER, THE METAL-SEMICONDUCTOR-METAL (MSM) PHOTODETECTORS CAN BE FABRICATED BASED ON THE POLY-GAN/POLY-SI MATERIALS SYSTEM TAILORING THEIR UNIQUE OPTOELECTRONIC PROPERTIES. DETAILS OF THIS WILL BE FOCUSED ON THE LOW-COST AND LARGE-AREA DEVICE APPLICATIONS. BASED ON OUR PRELIMINARY STUDIES, IT IS FOUND THAT STRONG ROOM-TEMPERATURE PL EMISSION (3.387 EV) WITH AN FWHM OF 120 MEV CAN BE OBTAINED FOR THE AS-GROWN POLY-GAN FILMS (~ 4 mM IN THICKNESS). THE GRAIN SIZE FOR POLY-GAN WAS RANGED FROM 3 TO 4 μM AS EXAMINED BY SEM. FROM VAN DER PAUW-HALL MEASUREMENTS, THE AS-GROWN POLY-GAN FILMS SHOW N-TYPE CONDUCTIVITY WITH CARRIER CONCENTRATION OF 2 ~ 7 × 1019CM-3. THE ELECTRON CONCENTRATION ARE HIGH FROM THE NATURAL N-TYPE GAN FILMS IN THE TWO STEP GROWTH SYSTEM (GAN AS BUFFER LAYER), AND SUCH HIGH ELECTRON CONCERTRATION FILMS CANN'T TO SUIT TO THE PRODUCTION OF SCHOTTKY-CONTACTED MSM UV DETECTORS. SO WE CHANGE TO SELECT ALN AS OUR BUFFER-LAYER GROWTH AT LOW TEMPERATURE ABOUT 500~600OC, AND TO CHANGE THE COMPONENT OF ALN IN THE ALGAN LAYER, THEN THE MAIN LAYER GAN WAS GROWN AT 1000OC. FROM VAN DER PAUW-HALL MEASUREMENTS, THE AS-GROWN POLY-GAN FILMS ALSO SHOW N-TYPE CONDUCTIVITY WITH CARRIER CONCENTRATION OF 2 ~ 7 × 1017CM-3. DUE TO THE I-V MEASURED RESULTS OF MSM UV DETECTOR BASED ON THE POLY-GAN/ALGAN/ALN/POLY-SI FILMS, (THE SIZE IS ABOUT 1 MM × 1 MM , THE LENGTH OF FINGER = 200 mM, WIDTH = 30 mM, SPACE = 30 mM) THE DARK CURRENT IS ABOUT 10-10A AT THE REVERSE-BIAS 5 V. FROM THE ILLUMINATION OF HE-CD LASER (325 NM LINE OF A 40 MW), THE PHOTOCURRENT OF THE ILLUMINATED MSM UV DEVICES HAVE THE CHANGE OF THREE ORDERS. THE MSM UV DETECTOR BASED ON POLY-ALGAN/POLY-SI MATERIALS HAS MANY ADVANTAGES THAN THE CONVENTIONAL DEVICES (E.G. PMT、SI OR GAP-BASED PHOTO-SENSORS COUPLED WITH UV TRANSMISSION FILTERS, AND DIAMOND FILMS). UV PHOTO-DETECTOR WHICH CAN SELECTIVELY DETECTS THE FLAME LUMINESCENCE WITHIN THE RANGE FROM 250 TO 280 NM IS CAPABLE OF DETECTING FLAMES AGAINST THE STRONG BACKGROUND OF SUN-LIGHT OR ROOM-LIGHT. BESIDES THAT, IT IS ALSO IMPORTANT FOR FLAME DETECTOR TO ACHIEVE LOW-COST, LARGE-SCALE AND HIGH SENSITIVITY TO ULTRAVIOLET LIGHT (1NW/CM2) PERFORMANCE. THEREFORE, WE HOPE TO DEVELOP THE NOVEL OPTOELECTRONIC MATERIALS AND APPLICATIONS FOR POLY-GAN/POLY-SI. IT IS EXPECTED TO OPEN A NEW RESEARCH FIELD FROM THIS ARTICLE.

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