MBE-Grown Devices
Room Swan A & Sandpiper - Session GD-MoP
MBE-Grown Devices Poster Session

GD-MoP-1 High Power Sb-Based Mid-Wave Infrared Diode Laser Arrays*, **Andy Lu**, C. Yang,* Air Force Research Laboratory

High power diode laser source in the 2-3µm spectral range are critical for numerous applications, including defense infrared countermeasures, remote gas sensing, and as pump source for solid state lasers. In this paper, we present high power diode laser arrays using antimonide-based diode laser architectures spanning the 2.0-2.7µmwavelength range. The diode laser structure used was designed for 2.0µm, 2.4µm, and 2.7µm emission and grown using molecular beam epitaxy on GaSb substrates. The active region consists of lattice-matched quinary alloy for 2.7µm and quaternary alloy for 2.0µm and 2.4µm waveguide and four compressively strained, InGaAsSb quantum wells laced at the center with an inter-well spacing of 50 nm. The n-type bottom-clad and the p-type top-clad layers were both 1.5µm-thick lattice-matched AlGaAsSb alloy layers doped with Te and Be, respectively. Four-bar stack arrays were processed, fabricated, and packaged with water-cooled microchannel cooler. We demonstrated continuous wave operation of these diode array stacks with output power of 25 Watts at 2.0µm, 15 Watts at 2.4µm, and >7 Watts at 2.7µm.

GD-MoP-2 High Performance Diluted III-V Multijunction Solar Cell Grown by MBE for Space Application*, **Prashant Tyagi**,* Orbit Engineering, LLC, India*; M. Sheldon,* Orbit Engineering, LLC*; T. Tabbakh, A. Albadri,* King Abdulaziz City for Science and Technology, Saudi Arabia

The III-V semiconductor materials have proven to be the most versatile group of materials due to direct and tunable band gap, robust, and radiation hardness properties.These versatile physical properties with relatively low mass-to-power ratio make III-V material an excellent candidate for space power application.Among all the space power technologies, compound semiconductor-based multijunction solar cells (MJSC) have demonstrated the highest efficiency of photovoltaic conversion.Most of the III-V semiconductor solar cells are based on heterostructure of InGaP/InGaAs/Ge.These solar cells are the core of satellite solar energy production [1-3]. Moreover, lattice-matched triple-junction III-V solar cell offers efficiencies of over 30% along with excellent performance and reliable stability for space missions [4]. The triple junction III-V is a well-established technology that has fulfilled numerous space applications over the past two decades. Currently, the highest conversion efficiency of solar cells is 47.1% achieved by six-junction inverted metamorphic solar cells exposed to 143 suns [5]. Our six junctions dilute III-V solar cell hybrid technology, which is an approach to further enhance the performance of III-V MJSC. Our aim is to develop the dilute MJSC technology which gives 36% conversion efficiency at AM0. Dilute nitrides are III-V compounds that incorporate small amounts of nitrogen (below 5%). The dilute nitrides exhibit excellent optical and electrical properties such as tunable band gap, which could be engineered to cover the entire range from 0.8 to 1.4 eV maintaining lattice matching to Ge. During our first on grown characterization, we achieved 20.6% efficiency under 1 Sun illumination and a current density of 7.2 mA/cm^2 with 79% fill factor. The details of growth and characterization would be presented at the conference.

References

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GD-MoP-3 Annealing Effect on the Magnetic Anisotropy of P Composition Graded GaMnAsP Layers*, **Seul-Ki Bac**,* Korea University*; S. Lee,* Korea University, Republic of Korea*; X. Liu, M. Dobrowolska,* Physics Department,*; J. Furdyna,* Physics department

We have investigated annealing effect on the magnetic anisotropy properties of $GaMnAs_{1-y}P_y$ thin film, in which phosphorus content *y* varies from 0 % to 24 % along the growth direction. The Hall effects measurement revealed that the portion of magnetic layers having either only in-plane easy axes, both in-plane and out-of-plane easy axes, or only out-of-plane easy axis in the sample to be 80 %, 10 %, and 10 %, respectively, in as-grown sample. Such gradual change of the magnetic anisotropy in the film from the in-plane to the out-of-plane anisotropy with increasing P concentration is in accordance with the continuous variation of the strain from compressive to tensile toward the film surface. However, thermal annealing significantly changes magnetic anisotropy of the graded $GaMnAs_{1-y}P_y$ film. In particular, the intermediate region having both in-plane and out-of-plane easy axes nearly disappears in the film after thermal annealing and the film is divided into two types of layers having either only in-plane or only out-of-plane anisotropy. This investigation shows that thermal annealing significantly changes the magnetic anisotropy of graded $GaMnAs_{1-y}P_y$ film and thus one can strategically use the process to realize orthogonal magnetic bilayer consisting of in-plane and out-of-plane easy axes.

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