Foreword

Special Issue on Quaternary Compound Semiconductor Materials and Devices—Sources and Detectors

TERNARY semiconductor alloys have been widely used in various device applications because of the ability to adjust the energy gap to a particular value, as, for example, in lasers, light emitting diodes, and detectors tailored to particular wavelengths. For many of these applications, however, the changing lattice constant with composition in the ternary alloys makes it impossible to obtain the required performance or to fabricate the desired structures at a particular wavelength or bandgap energy. The realization in 1970 by Holonyak and coworkers at the University of Illinois that a fourth element could be added to a ternary alloy to minimize lattice mismatch while maintaining the desired bandgap was an important first step in the development of these materials. The pioneering research on the InGaAsP/InP lattice matched system by workers at Varian, along with the development of doped silica fibers with low loss in the 1.0-1.5 μm wavelength range, led to an intensive world-wide research effort to develop suitable sources and detectors using this quaternary alloy. The AlGaAsSb/GaSb lattice matched alloy system also covers the 1.0-1.5 μm wavelength range and this material is now being widely studied for long-wavelength optical fiber applications.

This Special Issue of the IEEE JOURNAL OF QUANTUM ELECTRONICS is entirely devoted to these two quaternary materials systems. The papers have been grouped into three categories: 1) crystal growth and characterization, 2) lasers and light emitting diodes, and 3) detectors. The first two papers in category 1) discuss the phase diagram as a theoretical basis for the LPE growth of constant composition quaternary alloys. The third paper describes the results of vapor phase growth of (In, Ga)(As, P) obtained by Olsen and Zamerowski of RCA using the hydride process. The last three in the first category describe measurements on both VPE and LPE epitaxial quaternary materials. The first paper in category 2) describes work on InGaAsP lattice matched to GaAsP substrates. The short wavelengths obtained from lasers in this material could be especially important for future applications in video disk recording. The remaining papers in category 2) all deal with long wavelength InGaAsP materials lattice matched to InP substrates. These papers discuss recent results in LED's and lasers, including reliability and dynamic behavior. The last category contains papers on both nonavalanche and avalanche photodiodes, with three papers describing devices utilizing separate absorption and multiplication regions for comparison with the quaternary detector results. A paper describing recent results on low noise Ge avalanche photodiodes is also included. In addition to the InGaAsP photodiode work, two papers on InGaAsP phototransistors and photoconductive detectors, which represent different approaches to the detection process that may be important in future special applications, are included. The three final papers in this group describe work on GaSb and GaAlAsSb detectors.

The efforts of nearly 60 referees who contributed directly to this issue through reviewing the manuscripts were invaluable and I would like to thank them for their willing response and assistance in the choice of papers. Finally, I would like to thank Ms. Barbara L. Payne for her valuable assistance in the processing of the manuscripts and Ms. Beverly Surprenant for her helpful advice.

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Guest Editor