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A b s t r a c t

Title	Heterogeneous Optoelectronic Integrated Circuits Combined with Micro-LED Arrays and CMOS Drivers
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(800 words)

In this research heterogeneous integrated optoelectronic integrated circuits (OEICs) was proposed and designed and fabricated that have analog optical signal outputs composed of GaN-based LED arrays as prototypes of heterogeneous OEICs. Firstly, the scale of 8×8 micro-LED arrays and silicon driver were designed and fabricated following by evaluating of the electrical and optical properties. CMOS Pulse width modulation (PWM) generator was hand-designed, simulated and fabricated. The fabricated micro-LED arrays and driver were bonded by the flip-chip method, which used a gold compliant bump and anisotropic conductive adhesives to fabricate a single chip device. The fabricated silicon PWM driver was well operated and showed good control of the function of pulse modulation as compared with the sawtooth waveform and control signal in the frequency range of 1.3 to 300 kHz. Then, the advanced CMOS silicon driver was designed and fabricated for more compact and functional control of individual micro-LED arrays by introducing clock control and a transmission capacitor. 16,384 pixels of large scale micro-LED arrays and matrix addressable multi-structural silicon driver, which of the best integrated density ever presented, were designed and fabricated. The fabricated multi-structural silicon driver was well operated for addressable switching controls of micro-LEDs. The large scale micro-LED arrays and silicon driver were bonded by the flip-chip method, which used anisotropic conductive adhesives to fabricate a single chip device. Finally, the prototype OEICs devices with operating by optical interconnections were proposed, designed and fabricated. The back-side illuminated (BSI) photodiode was designed and demonstrated by newly proposed of practical method by utilizing MEMS and post-CMOS process. Additional process of CMOS process for fabrication of BSI photodiode, was proposed and described in detail. The operational amplifier circuit which for amplification of generated optical current by BSI photodiode, was designed and simulated. For integration of micro-LED arrays, CMOS driver and back illuminated sensor by flip-chip bonding method, various kinds of driver arrays with BSI sensors were designed. The optical current amplifier and PWM generator can be implemented as the prototype OEICs. The optical current can be amplified the minimum voltage value of 0.64 V and up to V_{DD} , due to the increasing the dark by applied reverse bias. As a result, optical current was modulated as the PWM wave that possible up to 85% of the inverted signal. As a result of this research, optical current was successfully converted to pulse width modulated signal for implementing of the optical interconnection.