III-8 Electrical Measurements of Devices Fabricated in Pulsed Arc Lamp Rapid-Zone-Recrystallized Silicon on Insulator—Charles E. Hunt, Department of Electrical and Computer Engineering, University of California, Davis, CA 95616.

Zone-melting-recrystallized (ZMR) silicon on insulator (SOI) typically employs graphite strip heaters or other low power density melting sources with relatively slow scanning speeds [1]. The results of thermal modeling simulations suggest that high quality SOI can also be obtained by high power density, line-source rapid zone recrystallization [2]. The advantage to rapid recrystallization is the shorter high temperature duration, with less damage to existing structures or impurity distributions in the sample and greater applicability to 3-D IC’s. To date, only line-source electron-beams [3] have been used for rapid recrystallization. This paper presents electrical measurements from active devices fabricated in SOI material processed in a rapid zone recrystallization system using a pulsed arc lamp line source.

The seeded polysilicon coated sample is rapidly preheated above 1000°C (in room air ambient) and scanned by a linear translator table under the zone; speed is of the order of 35 cm · s⁻¹. (By comparison, strip heater ZMR systems typically operate at 100 W · cm⁻² with scan speeds of 1 mm · s⁻¹.) The lamp energy is collimated by a plate optic to a 0.5-mm line with 8-kW · cm⁻² power density. A single lamp pulse melts the top film and the sample then cools by radiation. The sample is above room temperature for less than 15 s. The experimental apparatus and materials properties are reported elsewhere [4]. Three-inch Si wafers with 0.5-μm-thick ZMR material. The electrical results confirm the material quality suggested by SEM, TEM, and Nomarski observations. Reproducible results were obtained in FET’s down to 1-μm effective channel length. The process, with significantly higher throughput than one requiring a vacuum, has application to high-speed, dense circuitry. The process, with significantly higher throughput than the LOCOS process technology was employed.


Deep quenching of absorption (Δα > 10⁴ cm⁻¹) over a 0.9-meV spectral range brought about by field induced carriers has been observed directly for the first time at room temperature in a special AlInAs/GaInAs/AlInAs single quantum-well (SQW) MODFET for a modest gate voltage change from −0.6 to 1.5 V. The effect is well suited for several important and novel optoelectronic applications.

The modulation doped Al₀.₄₄In₀.₅₂As/Ga₀.₄₃In₀.₅₇As/AlInAs SQW (10 nm) structure was grown by MBE on an InP:Fe substrate. The recessed gate (1.6 μm long by 200 μm wide) MODFET’s [1] exhibit a maximum gm of 116 mS/mm with Vds = −0.5 V. An extension of the gate electrode was included in the design to form a 100 μm × 100 μm optical test pad over a contiguous part of the FET mesa. Optical measurements were carried out in the 1.0- to 1.7-μm range using the focused output from a monochromator. Photocurrent spectrum taken at zero bias shows characteristic absorption steps due to 2D subbands. To investigate the effect of gate bias on the absorption spectrum, the light was focused onto the optical test pad through the substrate, reflected off the Cr/Au electrode and was detected by a PbS photodetector. The gate-voltage induced modulation in the reflected light was measured using a lock-in amplifier.

The measured difference spectrum clearly shows a large change at the position of nᵢ = 1 exciton peaks with a maximum Δf/f of OF ≈ 1 percent. This amounts to Δα ≈ 10⁻⁴ cm⁻¹ which corresponds to total quenching of the excitonic absorption [2]. This interpretation is supported by the abruptness of the edge of the difference spectrum and the appearance of two features at the expected positions of the heavy and light hole exciton peaks. Weaker structures are also observed near the nᵢ = 2 and 3 absorption edges. The results are very reproducible from device to device.

The observed absorption change is primarily due to the filling of the generalized phase space (including 2D excitonic states) by free carriers. The change is more pronounced than those produced by quantum confined Stark effect [3] and by photocarriers [4]. It is