Increasing Photoluminescence of MBE-grown GeSn Alloys Using Thermal Annealing

Ruei-Jhang Wang[1], Yue-Tong Jheng and Guo-En Chang[1]

[1]Department of Mechanical Engineering and Advanced Institute of Manufacturing with High-Tech Innovations (AIM-HI), National Chung Cheng University, Taiwan

E-mail: imegec@ccu.edu.tw

Group-IV GeSn alloys has been considered as a new light emitting material for silicon photonics. By adding Sn to Ge, the energy band structure can be effectively modified into direct bandgap. GeSn alloys are usually grown at low temperature to suppress Sn segregation, but with a price of degraded material quality. Here, we present a study of using thermal annealing to enhance photoluminescence (PL) from GeSn thin films grown on Si substrate using low-temperature molecular beam epitaxy.

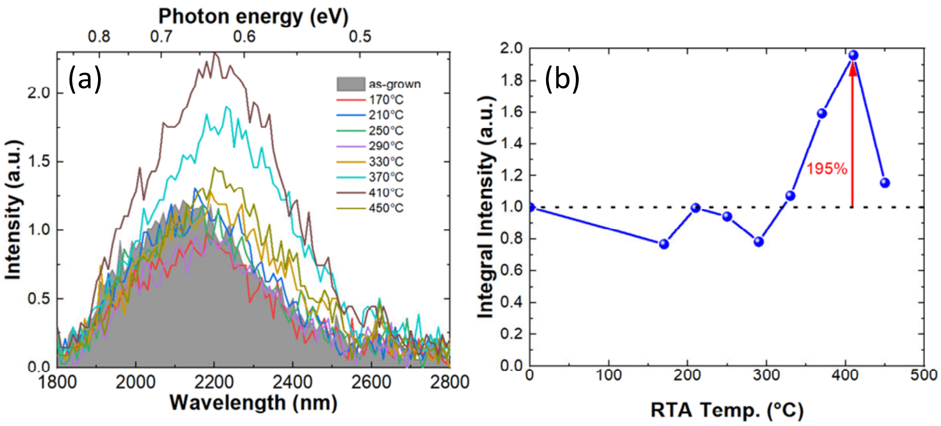

Figure 1. (a) Room-temperature PL spectra of GeSn sampled annealed at various temperature. (b) Integrated PL as a function of annealing temperature.

The GeSn sample used in this study consists of a 200 nm Ge buffer layer and a 300 nm GeSn thin film with a Sn content of 6% on a Si substrate. The sample was then diced into pieces and annealed in a N2 environments at various temperature for 30 seconds. Figure 1(a) shows the PL spectra of the annealed GeSn sample. The as-grown GeSn sample exhibits a single emission peak at 2200 nm, suggesting that the direct bandgap energy has been narrowed to 0.563 eV. With increasing the annealing temperature, the PL intensity increases up to a annealing temperature of 410 °C. The PL intensity then decreased as the temperature increased further. The PL intensity can be increased by 95% using thermal annealing.

Acknowledgment

This work at CCU was supported by Ministry of Science and Technology of Taiwan under the Grant Nos. MOST 111-2636-E-194 -002., MOST 112-2636-E-194 -001, and MOST 113-2636-E-194 -001.

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