

SiGe-Based Optoelectronic Devices 矽基光電元件

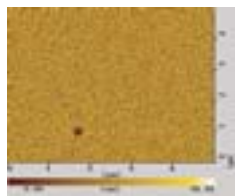
The adjustable bandgap in hetero-epitaxial SiGe/Si layers through tuning of Ge contents makes it possible to fabricate Si-based high-speed optoelectronic devices, such as light emitting diode (LED) and SiGe/Si heterostructure phototransistors (HPT), in nano-scale. The emission/detection wavelength is in the infrared range (850 nm~1550 nm). Being capable of integrating with mature Si ULSI technology, Si-based LED and HPT have the advantages of low-cost and high performance, and are suitable for optical interconnection and low-cost Gigabit Ethernet. ITRI has produced SiGe LED with quantum efficiency~ 1×10^{-4} . With a built-in gain, SiGe transistors with responsivity greater than 10 A/W are realized.

SiGe/Si異質磊晶結構，可藉由調整鍺含量進行能隙的調變，可用於製作奈米尺度的矽基高速光電元件，包括發光二極體（LED）、異質結構光電晶體（HPT）等。此元件的製作可和成熟的矽製程整合，並可應用於850~1550 奈米的光纖通訊用波段；因此矽基光電元件可用於建構未來所需之低成本、高速、高性能的光纖通訊系統。目前工研院已完成SiGe LED製作，其量子效率達 1×10^{-4} ，以及內建放大增益的SiGe電晶體，其光電反應能力大於10 A/W。

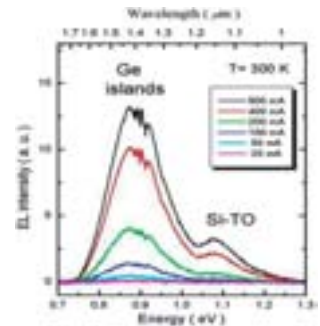
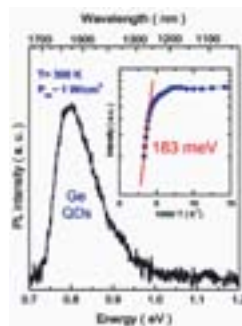
SiGe Light Emitting Diode



Ge-QDs formation: Self-assembly

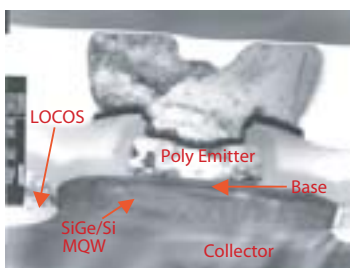
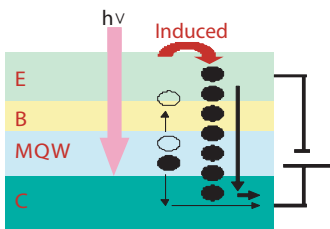


AFM: Density ~ $1 \times 10^{11} \text{ cm}^{-2}$

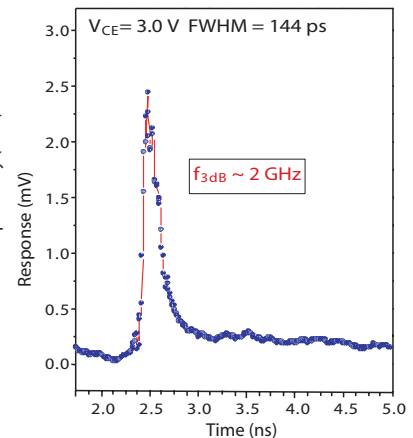
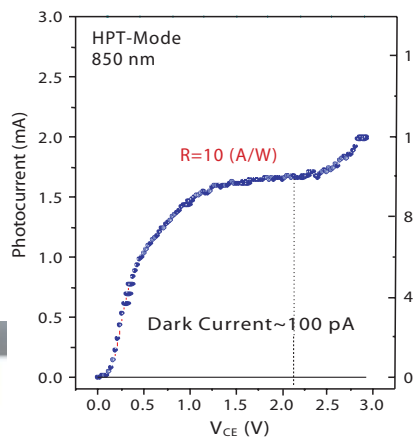


External Quantum Efficiency ~ 1×10^{-4} 2002/09

SiGe Phototransistor



TEM image of SiGe MQW Phototransistor



Responsivity > 10 A/W; Bandwidth > 2 GHz 2002/11