



Canadian Association
of Physicists

Association canadienne
des physiciens et physiciennes

Contribution ID: 3755

Type: Oral (Non-Student) / Orale (non-étudiant(e))

Photovoltaic properties of SiGeSn alloys fabricated by ion implantation

Wednesday 21 June 2023 16:45 (15 minutes)

The long-term objective of this project is to develop cost-effective, versatile, and scalable, short-wave infrared detectors directly integrated into silicon. Unlike the direct bandgap materials such as Si, Si_{1-x}Ge_x, and Si_{1-x-y}Ge_xSn_y provide a promising path toward Si-compatible devices for SWIR detection. In this project, Si (001) samples were implanted at room temperature with a tilt of 7 degrees, with 65keV Ge and 100 keV Sn at the Tandemron Accelerator lab, Western University, to achieve average Si_{0.80}Ge_{0.15}Sn_{0.05} concentrations over the top 100nm. After implantation, the samples were furnace-annealed at 400°C, and 600°C, for 30 minutes, in dry nitrogen gas, leaving one as 'as is' for comparison. Aluminum metal contacts were deposited at the surface of selected samples using lithography process for IV measurements, with Al round contacts of a diameter of 600 μm, 700 μm apart (Western Nanofab). Spectral response (SR), quantum efficiency (QE), current density, and the current-voltage (IV) characterization were performed on selected samples at Sciencetech Inc. In our IV measurements at room temperature, we found that the IV curves can be divided into three regions, Region 1, where we see the reverse bias current, which is the small leak current. In Region 2, Si_{1-x-y}Ge_xSn_y materials exhibit Ohmic behavior. And finally, Region 3 where the current does not change with voltage, this region operates like an ideal current source. More so, this IV curve passes through the origin, implying that it does not store energy. We see an interesting observation, in Region 2, the IV characteristic curve showed an increment in the current with respect to the voltage with the increase in the degree of annealing on the sample. All studied samples have maxima in the SR and QE responses at around 1099nm, and a broad plateau at 1600-1980 nm, respectively. Along with this, there is a slight incremental shift in the long wavelength of the spectral response for the annealed samples. Overall, there was a decrease in the maximum SR, QE, and current density of samples annealed at high temperatures, compared to as-is sample.

Keyword-1

SiGeSn alloys

Keyword-2

Photovoltaic properties

Keyword-3

Ion implantation

Primary author: Dr SHARMA, Nisha (Mitacs Postdoctoral fellow)

Co-authors: Mrs EKERUCHE, Chinenye (Graduate Student); Mr WALKER, Stephen (V.P. Technology, Sciencetech.Inc); Mr QUAGLIA, Alex (C.E.O, Sciencetech Inc.); Dr GONCHAROVA, Lyudmila (Professor)

Presenter: Dr SHARMA, Nisha (Mitacs Postdoctoral fellow)

Session Classification: (DCMMP) W3-3 Light and Matter | Lumière et matière (DPMCM)

Track Classification: Technical Sessions / Sessions techniques: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)