National Institute of Technology Rourkela

Departmental Seminar

Seminar Title	: Analysis of Capacitance-Voltage Measurements for Majority Carrier Depth Profiling of Phosphorus-doped Si nanowire'
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Venue	: Seminar Room, EE-401
Date and Time	: 13 Jan 2025 (5:30 PM)
Abstract	: Doping depth profile measurement for Si is essential for determining junction depth, leakage current, threshold current, and overall device parameters. However, the widely used sophisticated approaches such as secondary ion mass spectroscopy and electrochemical capacitance-voltage (ECV) measurement are destructive techniques. Further, these techniques are not preferred for doping measurement of Si nanostructures, especially Si nanowires (SiNWs), due to complex multidimensional depth profiling. The work utilizes non-destructive majority-carrier depth profile analysis of the SiNW array using dry capacitance-voltage (CV) measurement and addresses the oxide layer and air-gap issues. A boron-doped p-type SiNW array was fabricated by pre-optimized metal-assisted chemical etching. SiNW array was doped with P by spin-on-doping (spin-coating of P-containing phosphosilicate glass sol-gel followed by annealing), varying the P-concentration. P-concentration was varied in the sol-gel by varying the P2O5 concentration as 1.25 mM, 2.5 mM, 5.0 mM, and 7.5 mM. The Hall effect measurement estimates the surface carrier concentration as a reference for the differential CV measurement. The analysis estimates an effective doping depth and corresponding majority carrier concentration for the SiNW arrays with different doping concentrations. Due to the interstitial air gap formed by the SiNWs and the metal electrode, differential CV analysis overestimates the doping concentration and underestimates the doping depth. The differential CV analysis estimates the majority carrier concentration as 7.7 × 1026 cm-3 with an effective doping depth of 5.4 nm for the SiNW array doped with a P2O5 concentration of 5 mM.