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| **Title:** | Analysis of Electron Confinement in Semiconductor (Ge, GaN, and ZnO) Quantum Nanowires | | |
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| **Published Journal Name:** | EVERGREEN Joint Journal of Novel Carbon Resource Sciences & Green Asia Strategy | | |
| **Type of Publication:** | Journal | | |
| **Volume:** | 12 | Issue | 1 |
| **Publisher:** | Kyushu University | | |
| **Publication Date:** | March 31, 2025 | | |
| **ISSN:** | 2189-0420 | | |
| **DOI:** | https://doi.org/10.5109/7342435 | | |
| **URL:** | https://catalog.lib.kyushu-u.ac.jp/opac\_download\_md/7342435/p18-26.pdf | | |
| **Other Related Info.:** | Page 18-26 | | |
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| **Abstract:** |  |
| Quantum nanostructures show promising applications in scaling electronic devices due to their exciting electronic and optical properties. In this work, a comparison of electron densities and confinement capabilities of nanowires made of three semiconductor materials (Ge, GaN, and ZnO) at low temperature (T = 10 K) is done through numerical-based modeling. Numerical calculation is done using the Poisson-Schrödinger (PS) and Thomas-Fermi (TF) approximation equations through the finite element method. Physical phenomena of one-dimensional structures, e.g., charge density waves (CDW) and Friedel oscillations (FO) in these nanowires, have also been studied. Numerical analysis of electron densities and confining potentials exhibits FO in all of these Ge, GaN, and ZnO nanowires. Results showed that lower energy states having smaller values in azimuthal quantum number (m = 0, 1, 2) contribute the most to carrier density profile. Finally, all three materials show Fermi-level-pinned energy that has great impact on the possibility of photogeneration gain. | |