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Title: Long Wavelength Plasmonic Absorption Enhancement in Silicon Using Optical Lithography Compatible Core-Shell-Type Nanowires
Author(s): Sabuktagin, MS (Sabuktagin, Mohammed Shahriar); Hamdan, KS (Hamdan, Khairus Syifa); Sulaiman, K (Sulaiman, Khaulah); Zakaria, R (Zakaria, Rozalina); Ahmad, H (Ahmad, Harith)
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Abstract: Plasmonic properties of rectangular core-shell type nanowires embedded in thin film silicon solar cell structure were characterized using FDTD simulations. Plasmon resonance of these nanowires showed tunability from \( \lambda = 750 \text{ nm} \) to \( \lambda = 2400 \text{ nm} \) with variation of dimensional parameters within the feature resolution specifications of Deep Ultraviolet and Laser Interference Lithography techniques. A half-shell nanowire structure was proposed for simplifying device integration which showed 10 times absorption enhancement in silicon at \( \lambda = 940 \text{ nm} \). However this absorption was significantly smaller than the Ohmic loss in the silver shell due to very low near-bandgap absorption properties of silicon. Prospect of improving enhanced absorption in silicon to Ohmic loss ratio by utilizing dual capability of these nanowires in boosting impurity photovoltaic effect and efficient extraction of the photogenerated carriers was discussed. Our results indicate that high volume fabrication capacity of optical lithography techniques can be utilized for plasmonic absorption enhancement in thin film silicon solar cells over the entire long wavelength range of solar radiation.
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Addresses: [Sabuktagin, Mohammed Shahriar; Hamdan, Khairus Syifa; Sulaiman, Khaulah] Univ Malaya, Fac Sci, Dept Phys, Kuala Lumpur 50603, Malaysia.
[Zakaria, Rozalina; Ahmad, Harith] Univ Malaya, Photon Res Ctr, Kuala Lumpur 50603, Malaysia.
Reprint Address: Sabuktagin, MS (reprint author), Univ Malaya, Fac Sci, Dept Phys, Kuala Lumpur 50603, Malaysia.
E-mail Addresses: s1hahriar@yahoo.com
Author Identifiers:

<table>
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<tr>
<th>Author</th>
<th>ResearcherID Number</th>
<th>ORCID Number</th>
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<tbody>
<tr>
<td>ZAKARIA, ROZALINA</td>
<td>B-5370-2010</td>
<td>0000-0002-6445-3039</td>
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