Plasmonic Core-Multishell Nanowires for Optical Applications

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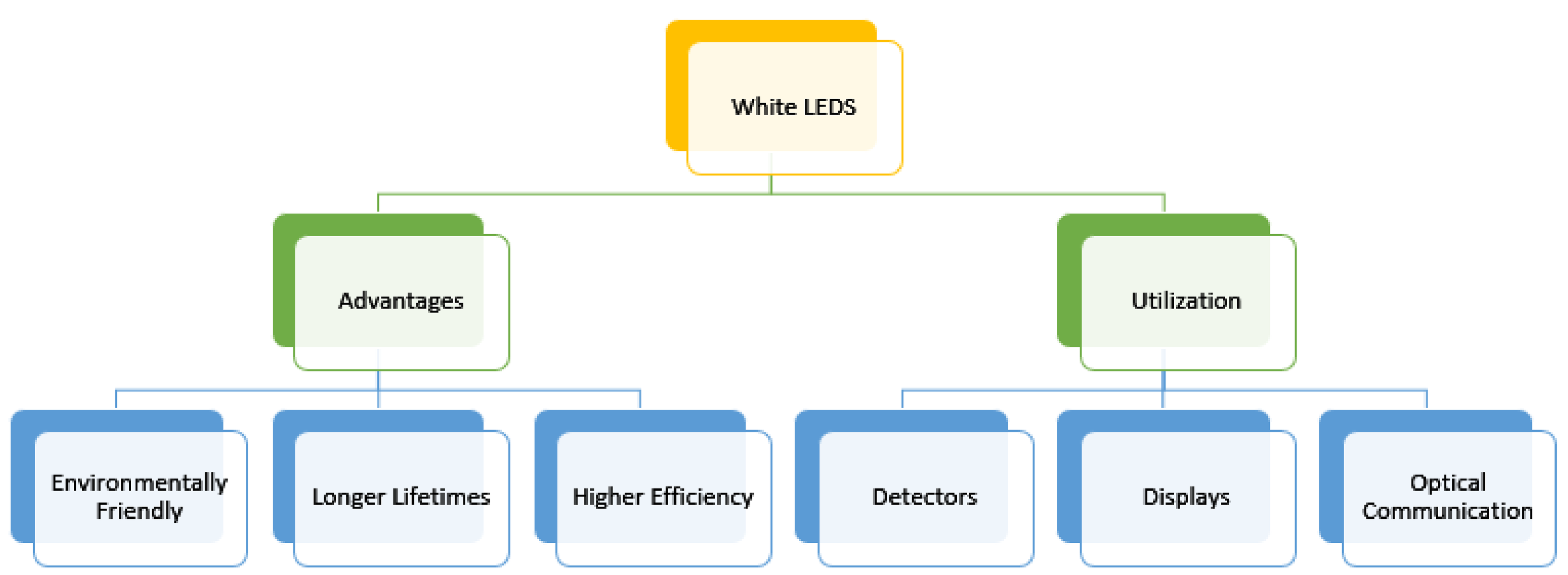
Background/Introduction

- White LEDs are much more useful when compared to traditional illumination.



- Uses at least 75% less energy, and lasts 25 times longer, than incandescent lighting.
- Core-Multishell nanowires will be used as phosphors for the white LEDs to improve its efficiency and color rendering.

References

- [1] Amartya Dutta, Sarath Ramadurgam, and Chen Yang, "Plasmonic Core-Multishell Nanowire Phosphors for Light Emitting Diodes", ACS Photonics 2018 5 (5), 1853-1862, DOI: 10.1021/acsphotonics.8b00069.
- [2] Lauhon, Lincoln J., et al. "Epitaxial Core–Shell and Core–Multishell Nanowire Heterostructures." Nature News, Nature Publishing Group, www.nature.com/articles/nature01141.

Methodology

- CS NWs are modeled as cylinders with infinite length and with the incident light perpendicular to it's axis.

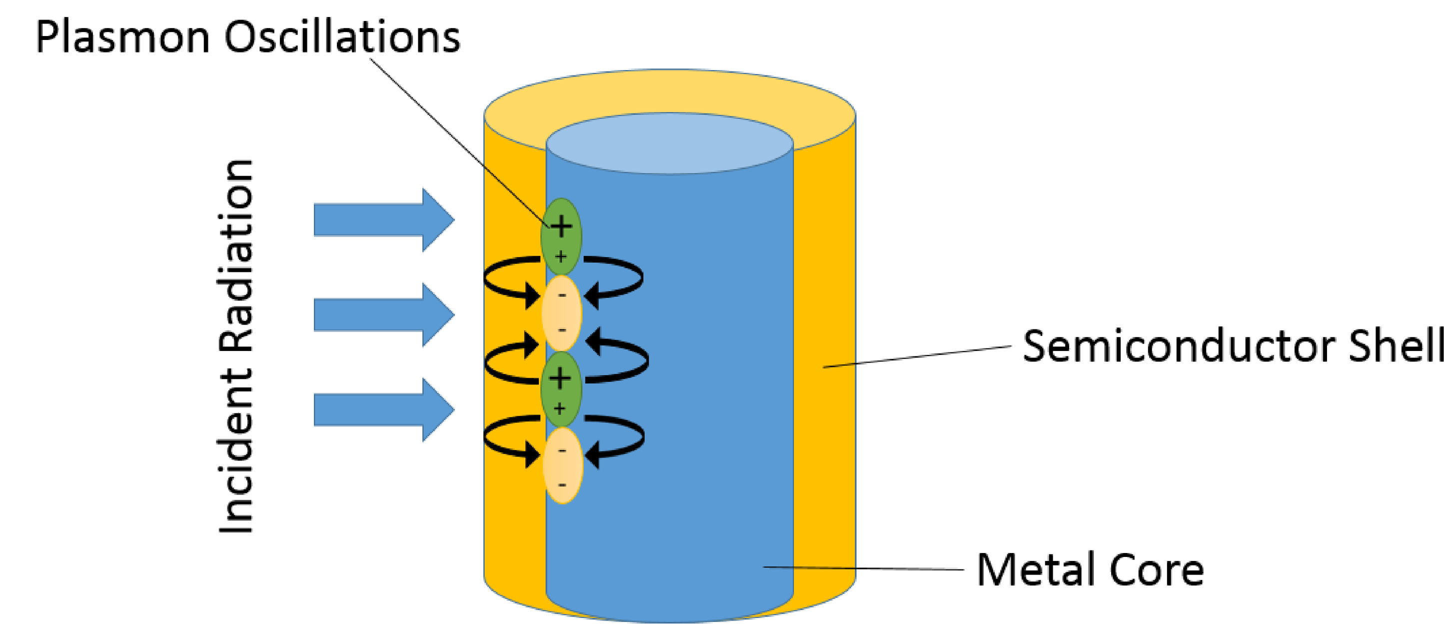


Figure 1: Core-multishell Nanowire

- To obtain a solution to Maxwell's equations, a Mie formalism was utilized to calculate the absorption properties of CS NWs.
- A Green's Function was applied to calculate LDOS (Local Density Of States) and Purcell Factor of the CS NW. The following is Green's Function for the inhomogeneous Helmholtz Equation:

$$(\nabla^2 + k^2)G(r, r_s) = \delta(r - r_s)$$
$$G(r, r_s) = \frac{1}{4i} H_0^{(1)}(k|r - r_s|)$$

- Specific codes were created to calculate such complex equations on the MATLAB programming language.
- New adaptions of these codes are currently being formulated to be added as functions for the existing tool.
- Graphs were formulated to aid with the results of these calculations.

Results

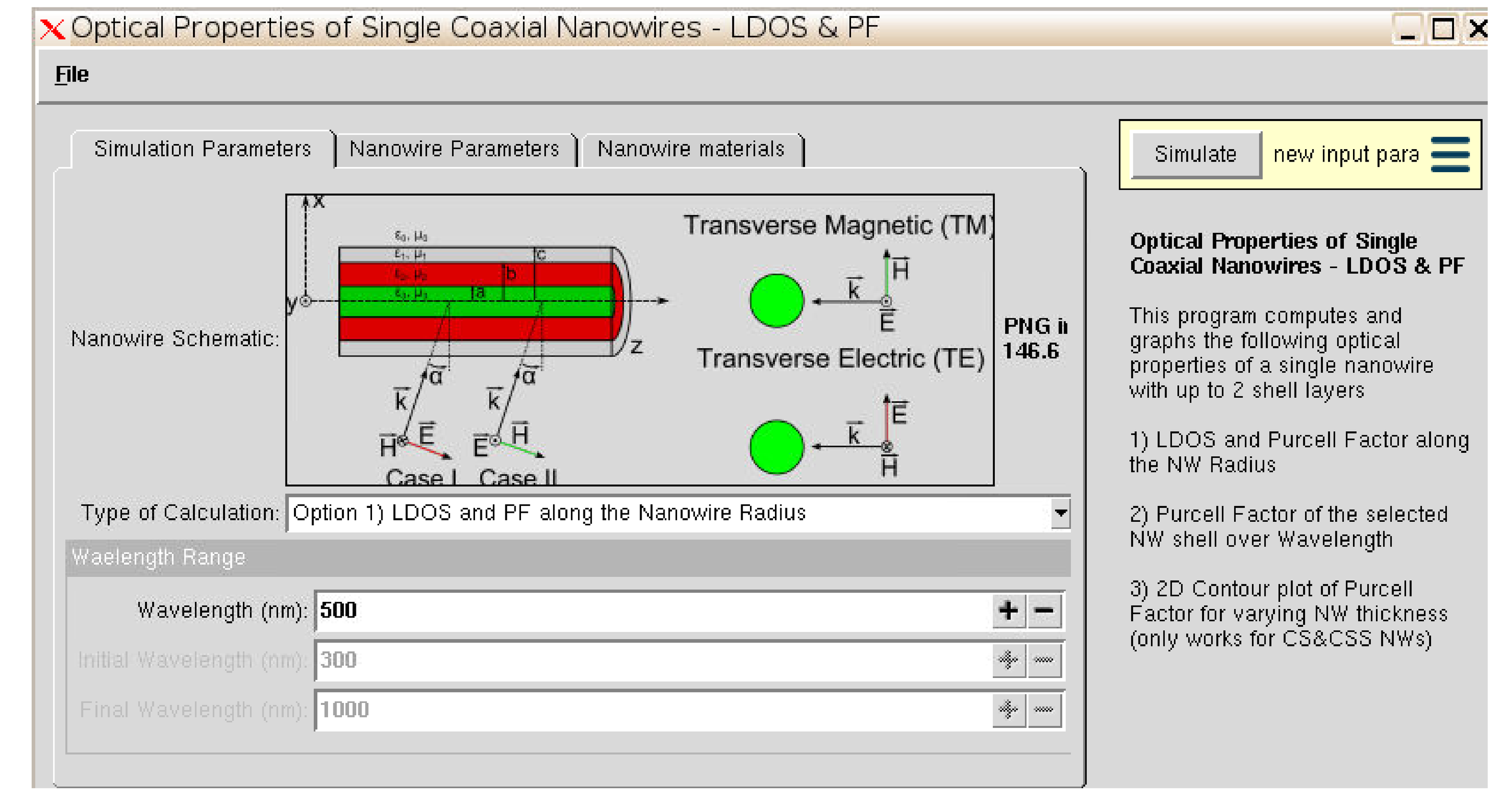


Figure 2: Rappture modification of existing tool

- The emission properties of CS NWs and nanowires were calculated.
- A few codes were implemented as functions on the tool.

Conclusion

In conclusion, users will be able to find out what materials and dimensions they can implement, to give them the greatest emission and absorption efficiency for core-multishell nanowires as phosphors in white LEDs. More functions will be added to the tool once the codes are fully operational so that it can be more affective.

Acknowledgments

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