# Scattering From ZnO Nanorods in Absorbing Perovskite Layer

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## Abstract

Perovskite materials seem a promising material for photovoltaic applications due to their low cost, strong light absorption, and benign defects [1]. ZnO nanorods provides a better alternative of nanostructured (NS) TiO2 electrodes which are generally used as electron transport layer in perovskite solar cells but suffers from low mobility [2]. Here in this paper we have tried to optimize light scattering from these ZnO nanorods. Scattering of light have been found to increase absorption of incident light resulting in better short-circuit current in solar cells [3]. Mie theory which is the most popular for evaluation of scattering because of its simplicity cannot be used for an absorbing surrounding media [4]. Hence scattering parameter to compare scattering from ZnO nanorods of different sizes, were calculated by solving Maxwell's equations using Finite element method with the help of COMSOL Multiphysics software. A spherical perfect matching layer (PML) was used for simulation, space between nanorods and PML was assumed to be filled with perovskite.

Scattering parameters are evaluated using far field expressions, but here due to surrounding medium being absorbing this method cannot be used. Extinction rate of electromagnetic energy per unit length of the cylinder is calculated by integrating appropriate Poynting vectors. As incident field is not constant in an absorbing media, average electric field was used to calculate the scattering efficiencies as suggested by Ruppin [4]. Lengths of nanorods were taken 500nm, 750nm and 1000nm for simulation. The refractive indices for this simulation were taken from literature [5]. This model developed here can be used for simulation of electromagnetic scattering from a cavity in metal as that problem is quiet similar to it.

## Reference

[1] M. Grätzel, Nat. Mater., 2014, 13, 838–842.
[2] B. Wu, K. Fu, N. Yantara, G. Xing, S. Sun, T. C. Sum and N. Mathews, Adv. Energy Mater., 2015, n/a–n/a.
[3] T. G. Deepak, G. S. Anjusree, S. Thomas, T. A. Arun, S. V. Nair and A. Sreekumaran Nair, RSC Adv., 2014, 4, 17615.
[4] R. Ruppin, Opt. Commun., 2002, 211, 335–340.
[5] C.-W. Chen, S.-Y. Hsiao, C.-Y. Chen, H.-W. Kang, Z.-Y. Huang and H.-W. Lin, J. Mater. Chem. A, 2014, 3, 9152–9159.