

## **Electromagnetic Scattering and Characteristic Mode Analysis of Nanowires in Layered Media**

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In practical applications, nanowires are typically fabricated either on top of a substrate or embedded within a multilayer structure as in the case of nano-composites. The presence of these multilayer structures has a strong effect on the electromagnetic scattering characteristics of the nanowires such as their radiation pattern, resonance frequency and the coupling between different nanowires. In many cases, in order to explicitly account for these multilayer structures, they are explicitly modeled in commercial solvers. However, this configuration is multiscale in nature because the spatial dimensions of these multilayers are usually significantly larger than the dimensions of the nanowires. Hence, a large number of discretization elements is typically required, which significantly increases the computational time and hinders the analysis and the optimizations of these nanowires in layered media. To efficiently simulate nanowires in a layered media, we employ the multilayer Green's function method with the rigorous Sommerfeld integral approach. In this approach, the effects of the multilayers are incorporated directly in the Green's function and no explicit discretization of the volume of the layers or their interfaces is required. There are several ways to numerically evaluate the Sommerfeld integrals in the Green's function formulation for multilayer structures. Examples of these methods are the Double Exponential and the Weighted Average methods. The main goal in this work is to compare the different Sommerfeld integral evaluation techniques to determine the most efficient approach to accurately simulate plasmonic nanowires with complex shapes and interconnects above and below lossy substrates. Results of our numerical experiments will be presented. In addition, we also used the Characteristic Modes Analysis to examine how the fundamental modes of these plasmonic nano-antennas and interconnects vary when the structure is placed at different locations inside different multilayer structures.