

Wideband Tunable and Non-Foster Mantle Cloaks

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We discuss the possibility of loading metasurface “mantle” cloaks with passive / active electronic circuitry to improve their tunability and increase their bandwidth of operation. The nature of the mantle cloaking technique, which is based on a patterned metallic surface aimed at cancelling the scattered field from an object of choice, is perfectly suited for integration with electronic components. Its ultrathin, conformal and non-resonant design has been shown both theoretically and experimentally to be able to significantly suppress the total scattering cross-section (SCS) of dielectric and conductive objects in cylindrical and spherical geometries. Here we explore practical designs of metasurfaces loaded with passive and active circuitry, such as varactors and non-Foster circuit elements, aimed at adding real-time tunability and increasing the bandwidth of operation of mantle cloaking technology.

As an example, we show in Figure 1 a conductive finite-length cylinder covered by a mantle cover, which produces an effective shunt capacitive surface impedance able to suppress the dominant scattering contribution from the bare cylinder. This ultrathin cover does not require a dielectric substrate and can be realized conformally to the bare rod. By loading the cloak with an off-the-shelf SVM 1231 varactor diode, the scattering suppression may be tuned across 1 GHz bandwidth. In Figure 1, we show the *Scattering Gain* as a function of frequency, defined as the total scattering cross section of the covered cylinder normalized to that of the bare object. We assume here the most relevant plane-wave illumination, with incident electric field polarized along the cylinder axis. A significant, and widely tunable, scattering suppression is observed around 2 GHz, and a higher-frequency scattering dip around 3.5 GHz is also observed, suggesting the possibility of single-layered dual-band cloaks.

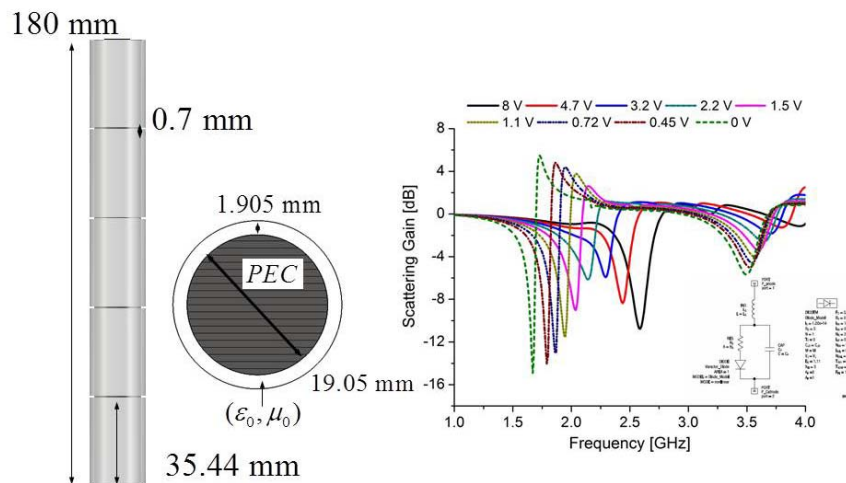


Figure 1. (Left) Finite length conductive rod covered by an ultrathin actively-loaded mantle cloak. (Right) Full-wave simulations of the tunable scattering reduction with a SVM 1231 varactor diode loading a capacitive conformal mantle cloak.