Scattering by a Hemisphere on a Metallic Plate

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The scattering of a plane wave of arbitrary polarization that is obliquely incident on a hemisphere lying on top of a metallic plane is considered. The analysis is conducted in the phasor domain, with a time-dependence factor $\exp(+j\omega t)$ that is omitted throughout.

The first step consists in obtaining the scattering by a full sphere immersed in free space when the incident plane wave is not propagating in a direction parallel to one of the axes of a rectangular coordinate system, by employing coordinate rotation. The second step consists in inserting a metallic plane through the center of the sphere, and utilizing the method of images to obtain the field scattered by a hemisphere on a metal plane.

Insofar as the medium inside the sphere, three different configurations are studied: first, an impenetrable sphere that is either a perfect electric or a perfect magnetic conductor; second, a penetrable sphere made of a linear, homogeneous and isotropic material characterized by arbitrary scalar values of permittivity and permeability; third, a metallic sphere coated by a penetrable concentric layer. In all cases, specific attention is devoted to the scattered far field and to the electric current density on the metallic portions of the structure. In particular, it is verified that in the cases of a metal hemisphere and of a hemispherical metal core, the current is continuous across the circle of intersection between spherical and planar portions of the metallic structure.