

**THE BREAKDOWN OF EFFECTIVE MEDIUM THEORY IN MULTILAYERED
HYPERBOLIC MATERIALS**

Richard Z. Zhang and Zhuomin M. Zhang*

George W. Woodruff School of Mechanical Engineering,
Georgia Institute of Technology, Atlanta, GA 30332, USA

* zhuomin.zhang@me.gatech.edu Tel: (01) 404-385-4225

ABSTRACT. Metal-dielectric multilayers can be designed to exhibit remarkable optical properties, including negative refraction for subwavelength superlensing. In this study, the applicability of the medium-homogenized effective medium theory (EMT) in place of multilayered thin-film optics is examined. Three different material and thickness combinations that give rise to hyperbolic dispersion in different spectral regions are considered. In addition to investigating the radiative properties, the energy streamline method is used to determine the refraction angle and lateral displacement. The electromagnetic fields inside the films are depicted to illustrate the coherent effect. The regime and mechanism for the breakdown of EMT are elucidated.