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Author: Prof. Junwu Zhang
Beijing Institude of Space Long Mach Vehicle, China, zjw813@139.com

Prof.Dr. Hongqiang Li
Tongji University, China, hqlee@tongji.edu.cn
Mr. Xiaopeng Su
China, 956863632@qq.com

THE INVESTIGATION ON METAMATERIAL FOR THE TRANSMISSION PROPERTIES OF ELECTROMAGNETIC WINDOW ON SUPERSONIC VEHICLE WITH VARIED THICKNESS

Abstract

During the re-entry of hypersonic vehicle into the atmosphere, the intense friction with atmosphere leads to high temperature and even ablation of radome shell. To protect antenna, remote sensing and electronic devices, and to ensure high transmission properties of electromagnetic waves, dielectric materials are utilized for electromagnetic window on supersonic vehicle. However, due to ablation, the thickness of dielectric window is varieddeviating from optimal thickness, and high transmission property cannot be preserved. Here, we design and fabricate a kind of metamaterial film for the transparency of electromagnetic window. The transparency at Ku band is sustained, over 85% for transmittance, even when the thickness of electromagnetic window varies in the range of 10mm to 50mm. The metamaterial film, attached inside the interior surface of electromagnetic window, is comprised of several layers of frequency-selective surface (FSS). The perfect transparency at interior surface of electromagnetic window arises from the near-field coupling of surface states on the adjacent FSS layers, in an analogue of electron tunneling through double-barrier potential in quantum mechanics. Such electromagnetic resonant tunneling can be qualitatively described with an effective medium model about single-negative index multilayers. As electromagnetic resonant tunneling eliminate the reflection from the interior surface of electromagnetic window, Fabry-Perrot resonance condition does not take effect, and the frequencies of transparency window is independent from the thickness of electromagnetic window.