Seminar

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Institute for Plasma Research

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Title : Development of $Ti_3C_2T_x$-MXene quantum dot and Ni-loaded nitrogen-doped carbon sheets-based X-Band Microwave Absorber

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Date : 02nd December 2024 (Monday)

Time : 02:00 PM

Venue : Seminar Hall, IPR

Abstract

The X-band frequency range of electromagnetic waves is crucial for satellite technology, wireless communication, radar, and other forms of communication. However, current electromagnetic absorption (EMA) capabilities in this range are insufficient, making the challenges of radar evasion and electro-smog more difficult to address. We demonstrate a novel EMA property of very high absorption in X-band in this study utilizing a composite that is 2 mm thick and has a low weight percentage of epoxy resin filling. Initially, we used hydrofluoric acid and hydrochloric solution to synthesize $Ti_3C_2T_x$-MXene from the MAX phase. The as prepared MXene were used as a precursor for the synthesis of zero-dimensional MXene quantum dot (QDs) by hydrothermal method. Then, we developed Ni@NCS/q-$Ti_3C_2T_x$/Epoxy composite by combining $Ti_3C_2T_x$-QDs with Ni-loaded nitrogen-doped carbon sheets (Ni@NCS) derived from pyrolyzed zeolitic imidazolate framework (ZIF). According to experimental results, the Ni@NCS/$Ti_3C_2T_x$/Epoxy composite's improved electromagnetic performance can be attributed to its large surface area, which allows for multiple electromagnetic wave reflection and scattering; its numerous defect sites, which encourage dipole and interfacial relaxation; and the optimized load matching achieved by integrating Ni magnetic nanoparticles with the conductive NCS/$Ti_3C_2T_x$ composite. These results validate the scientific and practical significance of the engineered composites in EMA applications within the X-band and useful for the development of highly effective electromagnetic absorbers.

Keywords: Microwave Absorption, Zeolite Imidazole Framework (ZIF).