# Electromagnetic Wave Absorption Properties of Carbon Nanocoil Composites in the Millimeter Waveband

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**Abstract.** Carbon nanocoil (CNC) is a carbon nanofiber with helical shape. In this study, we fabricated CNC-based composites endowed with electromagnetic wave absorption property. CNCs were synthesized by chemical vapor deposition using acetylene as a precursor and Fe and $SnO_2$ particles as catalysts. The composites were produced by dispersing CNCs into epoxy resin or paraffin by ultrasonication, and then hardening a droplet of the solution on an aluminum substrate with ca. 2mm in specimen thickness. Paraffin was used as a solvent when producing the composites with the CNC concentration higher than or equal to 5wt.%; otherwise epoxy was used. The reflection ratio of the composites with different concentrations were measured by the free space method using lens antennas in frequency ranges of 5.6–40 and 67–110 GHz. The CNCs/epoxy composites of 0.1–1.0 wt.% showed poor reflection losses. The 10 wt.% CNCs/paraffin composite achieved a reflection loss of −32 dB at 79.2 GHz. Its bandwidth corresponding to the reflection loss below −20 dB was 4.85 GHz. The CNCs/paraffin composite also turned out to show a good absorption property in W band frequencies (75–110 GHz).

## 1. INTRODUCTION

In recent years, with the progress of communication technology, the use of radio waves in the GHz band has been rapidly developed. As the use of these radio waves expands, problems such as health damage and device malfunctions are concerned. Electromagnetic wave shielding materials have been researched and developed as means for solving such problems. Although this shielding material can protect the shielded interior by reflecting electromagnetic waves, it is impossible to eliminate the reflected radio waves. Therefore, a radio wave absorber that absorbs the electromagnetic wave itself is necessary for the fundamental solution of the problem.

A radio wave absorber is an object that absorbs energy of an incident electromagnetic wave by converting it into thermal energy. There are various types of radio wave absorbers such as a single layer type, multilayer type, and pyramid type. The basic theory of wave absorption by radio wave absorbers is similar to that in distributed constant circuits. By matching the characteristic impedance of the radio wave absorber with that of the free space, the reflection

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