Semi-Automated Havriliak-Negami Analysis for the Investigation of Nanocomposite Properties

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Abstract. The complex permittivity of materials is a critical parameter in material diagnosis, as it describes their reaction to AC voltage. Researchers often use techniques such as the Cole-Cole diagram or the Havriliak-Negami equation to determine the frequency-dependence of complex permittivity. However, the interpretation of the Cole-Cole diagram can be challenging due to the overlapping contributions of multiple relaxation processes. In contrast, the Havriliak-Negami equation provides a more accurate and detailed characterization of the dielectric properties of amorphic materials. This paper presents a simple semi-automated application of the Havriliak-Negami equation to evaluate the influence of nanoscale fillers on the properties of polyester-imide resins. Nanocomposites, which are composite materials in which one or more components have a nanoscale dimension, are promising candidates for a wide range of applications due to their ability to significantly enhance the electrical, mechanical, and thermal properties of polymers. In this study, the researchers examined the influence of nanoscale fillers on the electrical properties of polyester-imide resins, which are commonly used as insulating materials in electrical rotating machines. The analysis presented in this paper provides an alternative indicator of the practical applications of nanocomposite dielectric materials. By examining the material in an unconventional manner, researchers can obtain new insights into their electrical properties and their potential for use in electrical rotating machines. The development of new dielectric composite materials can contribute to the improvement of the performance and efficiency of electrical machines, which is essential for the transition to a low-carbon energy system.