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Advanced Fibrous Structures for Shielding of High Frequency Electromagnetic Radiation

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ABSTRACT
Many devices, such as electric motors, digital computers, calculators, vending machines, terminals, printers, modems, electric typewriters, digital circuits, transmission lines, household electrical appliances, and mobile phones, are capable of emitting electromagnetic waves, resulting in electromagnetic interference problems
The main reason for the rapid extension of artificial electromagnetic field source generation is the massive development of widely accessible wireless information (as 5G or 8G frequency systems), internet-based technologies, electronics/microelectronics, especially micro and nanodevices, and high-frequency telecommunications technology. These technologies and devices have been penetrating everyday life in recent decades, which requires the need to protect humans and sensitive electrical and electronic devices from the undesirable effects of electromagnetic interference signals and electric charges.
EMI shielding is generally a tool designed to weaken the field of interfering signals in a defined space. The technical means (barriers, enclosures, constructions) by which above objective is achieved are therefore used. Shielding is used today to protect both individual components and functional blocks, as well as entire electronic devices, which can be both sources and receivers of electromagnetic interference. Last but not least, the principles of shielding serve to protect the person himself from dangerous fields, or devices ensuring the protection of health and vital functions (e.g. pacemakers, etc.).
The main aim of this lecture is to show various approaches to the prediction of shielding efficiency SE for shielding barriers without discontinuities and with apertures, including lightweight porous fibrous structures. These structures possess special qualities, including low density, excellent flexibility, light weight, ease of processing, and ease of handling. The basic methods for measuring and predicting the SE of these structures are mentioned, and different ways of enhancing their conductivity are discussed. Some of the fibrous structures most suitable for meeting EMI shielding functionality and also all wearability criteria, such as breathability, comfort, sustainability, and non-hazardousness, are shown. Hybrid fibrous structures containing conductive components and polymeric fibrous-based conductive composites are beneficial in EMI shielding due to their unique properties, which include lower density and excellent flexibility, and are described in detail.
Special coating material adhering to both macro and micro substrates through a variety of coating methods, such as brush coating, spray coating, and dip coating, by modulating the multiple interactions among the coating components as metallic particles, carbon allotropes, conductive polymers, and polydopamine (PDA) in both macro and microscale, is presented. A variety of polymeric materials, including fibers, yarn, woven, nonwoven, knitted structures, and their hybrid composites, are proposed.

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