

The Eurasia Proceedings of Science, Technology, Engineering and Mathematics (EPSTEM), 2025

Volume 36, Pages 39-47

ICBAST 2025: International Conference on Basic Sciences and Technology

Fabrication and Characterization of FeMnCo/Nanofiber for Radar Absorbing Material by Electrospinning

Kadir Asrin Sari

Özdemir Bayraktar Aerospace Technologies Vocational and Technical Anatolian High School

Umit Erdem

Kırıkkale University

Ugur Sari

Kırıkkale University

Abstract: With the rapid advancement of modern radar technologies, the development of materials capable of attenuating or eliminating electromagnetic wave reflection has become a critical area of research in electromagnetic interference (EMI) shielding and radar stealth engineering. These materials are not only essential for reducing radar detectability in military applications but also for safeguarding sensitive electronic systems and minimizing electromagnetic exposure in biological systems. This study focuses on the fabrication and characterization of a high-performance radar absorbing material effective in the X-band and Ku-band frequency ranges, which are commonly used in advanced defense radar systems. A novel nanocomposite was developed by incorporating 40 wt% FeMnCo alloy particles into a polyacrylonitrile (PAN) matrix via electrospinning. The resulting nanofiber architecture exhibited a uniform, cross-linked network with fiber diameters ranging from 200 to 400 nm, as confirmed by Scanning Electron Microscopy (SEM). X-ray Diffraction (XRD) confirmed uniform nanofiber formation and phase stability. Electromagnetic wave absorption properties were evaluated using a Vector Network Analyzer (VNA). The composite exhibited broadband absorption behavior with reflection loss (RL) values below -20 dB across both the X and Ku bands, indicating excellent radar attenuation performance. A minimum RL of -67.59 dB was recorded at 15.40 GHz, demonstrating the material's strong potential for stealth and EMI shielding applications. The findings highlight the synergistic effect of ferromagnetic FeMnCo alloy particles and the high surface area of the nanofibrous morphology in enhancing dielectric and magnetic loss mechanisms. This work contributes to the growing field of radar absorbing materials by offering a scalable and efficient approach to next-generation stealth technologies and electromagnetic protection systems. Future studies may focus on optimizing the composite's thickness, multi-layer configurations, and environmental durability to further improve real-world applicability and long-term performance.

Keywords: Electromagnetic wave absorption, Radar absorbing material (RAM), Nanofiber, Electrospinning

Introduction

The development of materials with the ability to absorb electromagnetic (EM) waves is of critical importance in areas such as radar systems, electromagnetic pollution control, and communication security (Abdalla et al., 2023; Ruiz-Perez et al., 2022). Today, both civil and military security challenges necessitate the development of specialized materials designed to prevent radar systems from detecting objects through electromagnetic waves, and intensive research efforts are being conducted in this context (Du et al., 2024; Saeed et al., 2024). Radar absorbing materials (RAMs) are strategic materials that find wide application in low-visibility technologies for military systems, in coatings designed to mitigate the effects of electromagnetic radiation, and in protective

- This is an Open Access article distributed under the terms of the Creative Commons Attribution-Noncommercial 4.0 Unported License, permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

- Selection and peer-review under responsibility of the Organizing Committee of the Conference

© 2025 Published by ISRES Publishing: www.isres.org

clothing (Kim et al., 2023). These materials operate primarily through two different mechanisms to suppress or eliminate reflected electromagnetic waves (Kim et al., 2023; Ruiz-Perez et al., 2022). The first mechanism involves the attenuation of EM waves within the material through dielectric and magnetic losses, whereby the wave energy is dissipated and converted into heat. The second mechanism is based on the penetration of the wave into the material, its reflection from the back surface, and its return to the inner front surface, thereby generating multiple internal reflections (Figure 1).

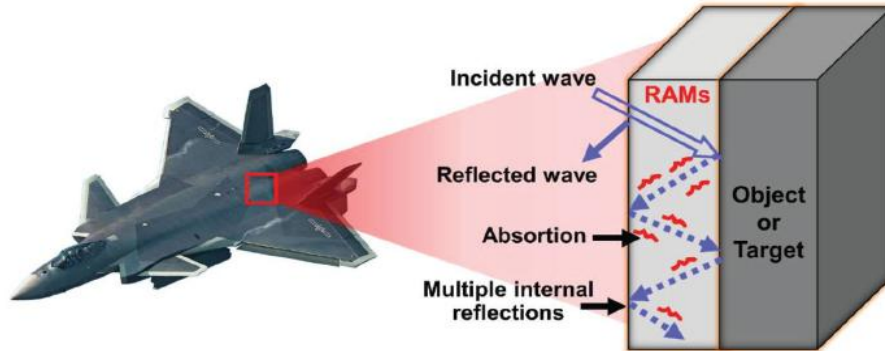


Figure 1. Attenuation mechanism of EM waves in RAMs (Kim et al., 2023)

In conventional RAMs, metals, metal powders, ferrites, conductive polymers, and various dielectric materials have been employed as the absorbing phase (Abdalla et al., 2023; Huang et al., 2020). However, these materials are often limited in practical applications due to their high density, poor corrosion resistance, heavy structures, or low absorption efficiency within restricted frequency bands (Jia et al., 2018). Consequently, research efforts have shifted toward the development of next-generation RAMs that are lightweight, electrically and magnetically conductive, thermally stable, corrosion-resistant, and capable of achieving high absorption over a broad frequency range (Huang et al., 2020; Kim et al., 2023). In recent years, advancements in materials science have facilitated the replacement of traditional absorbers with innovative approaches based on carbon-based materials, ceramics, and nanofiber architectures (Cai et al., 2024). Among these, the electrospinning technique has attracted significant attention, as it enables the fabrication of lightweight, flexible nanofiber structures with high surface area (Li et al., 2023). Moreover, this method allows the incorporation of various additives to further enhance the absorption performance of the nanofibers (Abdalla et al., 2023; Huang et al., 2020).

Transition metals such as Fe, Ni, and Co have attracted considerable attention as magnetic absorbers due to their high magnetization and permeability and are frequently employed as dopants in electrospinning processes (Wang et al., 2019; Xu et al., 2024). In particular, magnetic oxides such as Fe_3O_4 (Bayat et al., 2014; Pan et al., 2020) and MgFe_2O_4 (Liao et al., 2022) have been widely used as additives in electrospun nanofibers. Liu et al. (2016) reported that CoO-doped nanofibers exhibited a minimum reflection loss (RL) of -25.7 dB at a thickness of 2 mm. For magnetic oxides, electromagnetic absorption mainly arises from magnetic losses, as their electrical conductivity is relatively low. This limitation can be overcome by incorporating alloys that combine strong magnetic properties with good electrical conductivity. For instance, Chai et al. (2024) fabricated FeCo alloy nanoparticle-doped nanofibers, achieving effective absorption performance at a thickness of 1.2 mm and a frequency of 4.2 GHz. Similarly, Du et al. (2024) demonstrated that FeCoNi-doped carbon nanofibers achieved strong absorption with a minimum RL of -69.3 dB at 6.8 GHz with a thickness of 1.82 mm.

In the current literature, research on nanofiber-based electromagnetic wave absorbers using magnetic alloys as additives instead of ferromagnetic metal oxides is relatively limited. In particular, there are no studies using magnetic alloy particles obtained in ingot form as additives in nanofiber-based electromagnetic wave absorbers. This highlights the novelty of our work in developing ultrathin, lightweight, and broadband effective EM wave absorbers. In this study, radar absorbing materials with lightweight, flexible, and broadband high-absorption capability were developed by integrating FeMnCo-based magnetic alloys into electrospun nanofiber matrices. Through this approach, the synergistic effects of dielectric and magnetic losses were harnessed to overcome the performance limitations of conventional RAMs and address the current gap in literature. Accordingly, PAN nanofiber doped with ferromagnetic FeMnCo alloy particles were fabricated via electrospinning, and its electromagnetic wave absorption properties were investigated. The microstructure and absorption characteristics of nanofibers containing 40 wt% FeMnCo alloy were systematically studied.

Method

In this study, FeMnCo doped nanofiber was produced by electrospinning solutions containing alloy particles. The FeMnCo alloy used was prepared from bulk material containing 17.3% Mn and 4.6% Co by weight. As reported in the literature (Sarı & Kırındı, 2010), this alloy was heated in a furnace at 1200 °C for 12 hours and then rapidly immersed in room-temperature water to acquire ferromagnetic properties. This magnetic property was the primary reason for its selection in this study.

The alloy was obtained in powder form using a diamond file. The resulting FeMnCo alloy particles were combined with polyacrylonitrile (PAN) polymer and dimethylformamide (DMF) used as a solvent to prepare a solution suitable for electrospinning. The fabrication steps are schematically presented in Figure 2. In the first step, 1.11 g of PAN was dissolved in 10 mL of DMF to reach a concentration of 10% (by weight). Then, 40% (approximately 5.4 g) of FeMnCo alloy particles were added to this solution. The mixture was continuously stirred on a magnetic stirrer for 24 hours to ensure a homogeneous distribution. The homogenized solution was transferred to a 10 mL syringe and subjected to electrospinning. Electrospinning parameters were set as 14 kV applied voltage, 1 mL/h feed rate, and 17 cm tip-collector distance. After the solvent evaporated, the fibers formed were collected on aluminum foil and dried at room temperature to obtain the nanofiber structure.

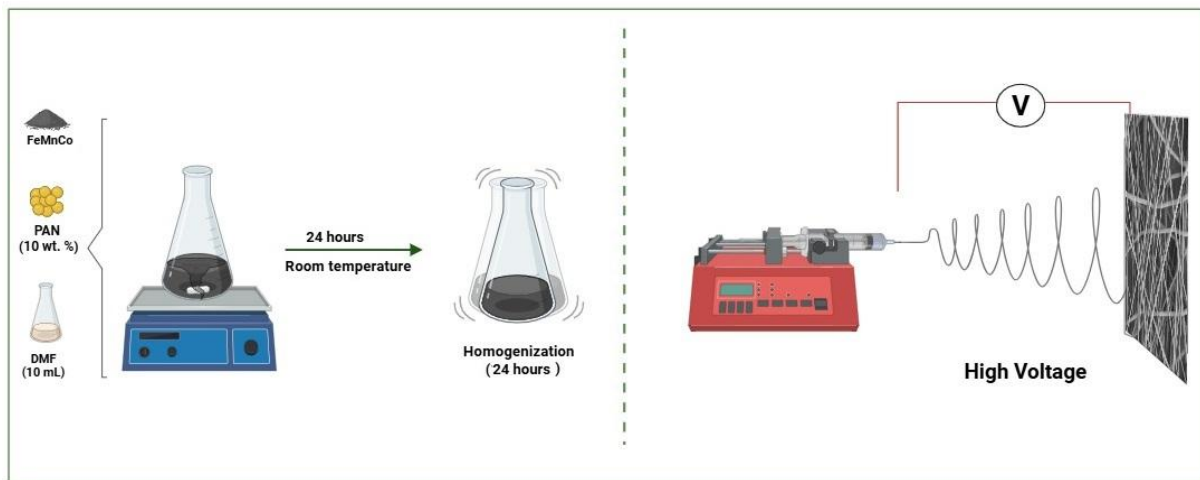


Figure 2. FeMnCo doped PAN nanofiber fabrication scheme

The surface morphology of the produced nanofiber was examined by scanning electron microscope (SEM, HITACHI SU5000). X-Ray diffraction (XRD) measurements to determine the phase structures of the nanofiber sample were carried out on a Bruker D8 Advance instrument using $\text{CuK}\alpha$ ($\lambda = 0.15406$ nm) radiation and a 2θ range of 10° – 80° . EM wave absorption performance was evaluated by reflection loss (RL) measurements. RL tests were performed with a Keysight N5224B vector network analyzer; samples for X-band (8–12 GHz, WR90 adapter) and Ku-band (12–18 GHz, WR62 adapter) measurements were prepared in accordance with the waveguide dimensions.

Results and Discussion

Morphological and Structural Analysis

The surface morphology of FeMnCo doped nanofiber is presented in Figure 3. SEM-based morphological studies show that the fibers are distinctly one-dimensional, with an average diameter ranging from 200 to 400 nm and a very high length-to-diameter ratio along the long axis. These thin-diameter and long fiber structures provide a high specific surface area, allowing electromagnetic waves to travel longer distances within the material and, therefore, contributing to greater energy loss due to multiple interactions (Li et al., 2023). In addition, a three-dimensional, cross-linked, and anisotropic network morphology formed by the overlapping of fibers in different orientations was observed in SEM images. Such structures allow the deflection of electromagnetic waves, the formation of multiple internal reflections, and enhanced energy absorption through increased scattering (Cai et al., 2024). These fibers doped with the FeMnCo alloy are expected to have high electrical conductivity due to the presence of metallic conductive phases in the polymer matrix. Such a conductive network structure enables the EM waves to undergo multiple scattering between the fibers and their energy to be gradually absorbed (Erdem et al., 2025; Cai et al., 2024).

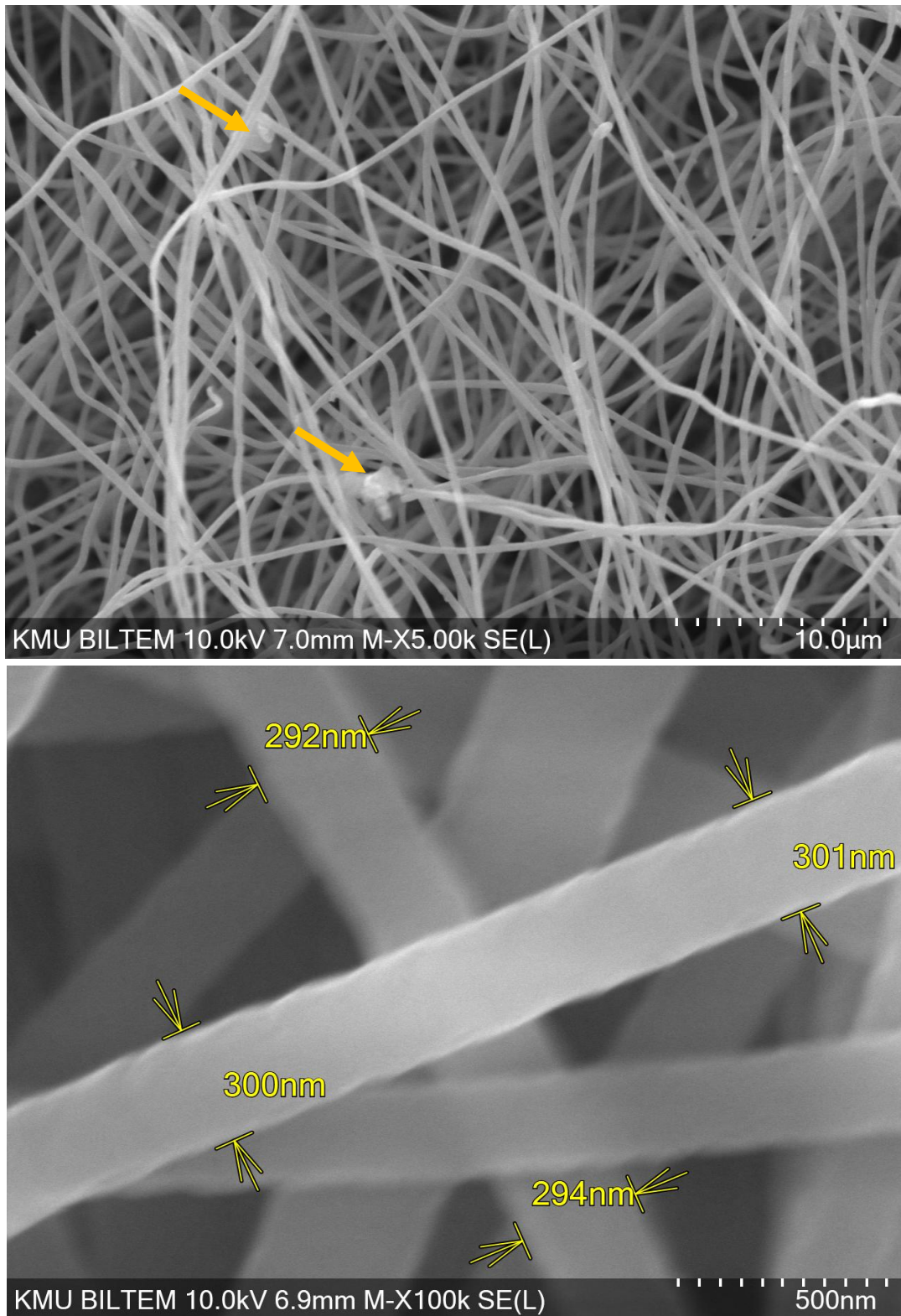


Figure 3. SEM image of FeMnCo doped PAN nanofiber (arrows indicate the agglomerations)

Detailed SEM analyses of the nanofiber sample indicated the presence of distinct particle agglomerations (dense clusters) in some areas (see Figure 3). Alloy powders were obtained by mechanically abrading the FeMnCo alloy ingot with a diamond file and then homogenized in the PAN solution using a magnetic stirrer. Because this method provides low-energy mixing, it is possible that the powder particles are not fully dispersed and may form dense clusters in places. These clusters can lead to morphological defects such as bead formation, increased roughness, and discontinuities on the fiber surface, disrupting the continuity of the conductive network within the composite and thus reducing EM absorption performance (Karbowniczek et al., 2022).

Alternatively, using a high-shear homogenizer instead of a magnetic fish stirrer could significantly reduce the risk of agglomeration by more effectively dispersing the alloy particles in the solution. Furthermore, instead of using the powders obtained after filing, subjecting them to size reduction and surface activation using ball mills or mechanical grinding methods could contribute to a more uniform particle distribution and a more suitable distribution for electrospinning. Such improvements could improve electromagnetic absorption performance by allowing for a more uniform fiber morphology and, consequently, the formation of a more stable conductive network (Erdem et al., 2025).

The crystal structure and phase combinations of the FeMnCo-nanofiber sample were investigated in detail by XRD analysis, and the resulting diffraction pattern is presented in Figure 4. Two broad diffraction peaks characteristic of polyacrylonitrile (PAN), used as the polymer matrix, were identified in the diffraction pattern. The first of these peaks is observed in the range of approximately 10–20° and corresponds to the (110) plane of carbon, and the second is located in the range of 25–34° and represents the (002) plane of carbon (Dong et al., 2022; Kahraman et al., 2018). These broad peaks confirm the presence of amorphous and semi-crystalline regions of PAN and also reveal the irregular packing structure of the carbon chains. In addition to the peaks belonging to PAN in Figure 4, sharp diffraction peaks specific to the FeMnCo alloy phases are also observed. This indicates the presence of metallic alloy phases in the nanofiber structure obtained by the electrospinning method. In particular, the coexistence of peaks corresponding to the martensite and austenite phases of the FeMnCo alloy in the diffraction pattern is striking. As reported by Sarı and Kırındı (2010), three different crystal structures can be found stable in the FeMnCo alloy under appropriate heat treatment conditions: α' -martensite with a BCC crystal structure, ε -martensite with a HCP crystal structure, and γ -austenite with a FCC crystal structure. Of these phases, α' -martensite, in particular, stands out as the phase that determines the ferromagnetic properties of the alloy due to its high magnetic moment.

In the diffraction pattern seen in Figure 4, three distinct diffraction peaks corresponding to the (311), (110), and (200) planes of the α' -martensite phase (Wang et al., 2018), the (111), (200), and (220) planes of the γ -austenite phase (Wang et al., 2020), and the diffraction peak corresponding to the (002) plane specific to the ε -martensite phase are clearly defined (Sarı & Kırındı 2010). These results indicate the coexistence of a triple phase in the nanofiber structure and the high microstructural diversity of the material. In addition, the coexistence of different crystalline phases can create synergistic effects on the mechanical strength, electrical conductivity, and electromagnetic wave absorption capacity of the material. In this context, the obtained XRD results reveal that the FeMnCo-nanofiber composites provide a multiphase microstructure optimization in terms of both structural and functional properties.

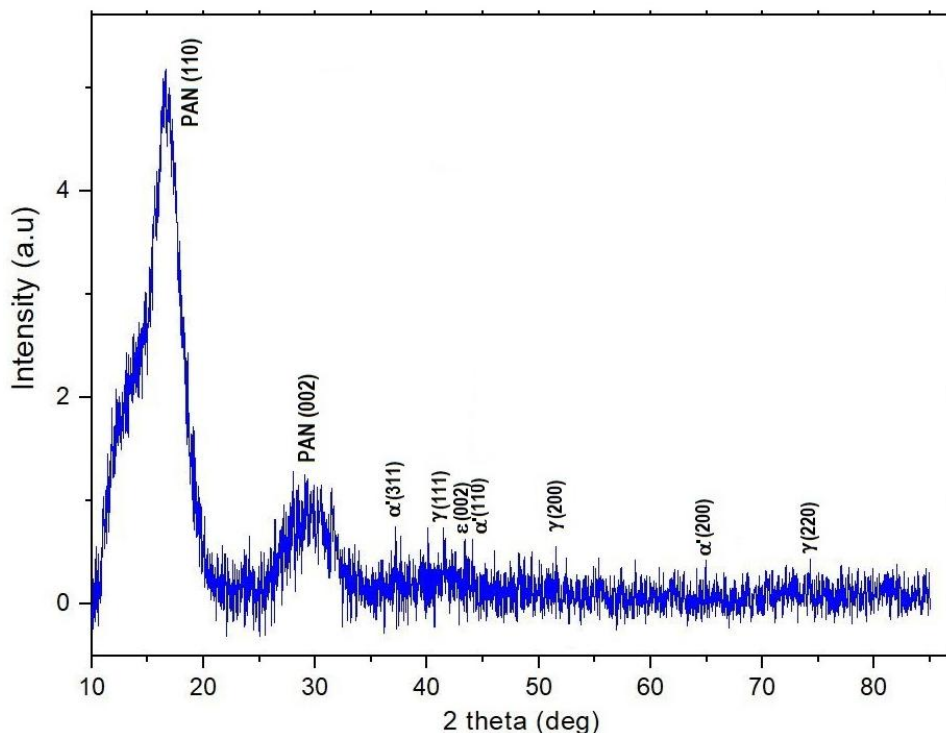


Figure 4. X-ray pattern of FeMnCo-nanofiber

Electromagnetic Absorption Performance

The EM wave absorption properties of the FeMnCo-doped nanofiber composite were evaluated using reflection loss (RL) values obtained in the frequency range of 8–18 GHz. As shown in Figure 5, the measured RL values are generally below the -20 dB level across both the X-band (8–12 GHz) and Ku-band (12–18 GHz). In literature, a limiting value of -10 dB is defined as the minimum acceptable performance criterion demonstrating that the material can absorb at least 90% of electromagnetic waves (Li et al., 2018; Ruiz-Perez et al., 2022). The values below -20 dB obtained in this study indicate that the composite can achieve high-efficiency EM wave absorption. The highest absorption performance of the nanofiber sample with a thickness of 1.2 mm was achieved with an RL value of -67.59 dB measured at a frequency of 15.40 GHz. This magnitude represents almost complete absorption at the relevant frequency, indicating that the reflection of EM waves from the material surface is negligible. As stated in the literature, for the electromagnetic absorption mechanism to be effective, the incident wave must enter the material with the lowest possible reflection (Kim et al., 2023). This is related not only to the low RL value but also to the impedance matching (Erdem et al., 2025).

Dong et al. (2022) carbonized PAN nanofibers produced by electrospinning by heat treatment and achieved a minimum RL value of -12.75 dB in the Ku band. Compared to our study, the PAN nanofiber doped with FeMnCo alloy in this study showed a significant performance improvement compared to the previous study, reaching RL values of -20 dB and below in both the X and Ku bands. This result indicates that the FeMnCo doping significantly improves the EM wave absorption capacity of PAN nanofibers. The incorporation of FeMnCo alloy particles into the composite indicates that dielectric loss and magnetic loss mechanisms are activated together in electromagnetic wave absorption (Erdem et al., 2025; Xu et al., 2024). FeMnCo is a multi-component alloy that combines high electrical conductivity and strong ferromagnetic properties. Conductive alloy particles dispersed within the fiber matrix extend the path of incident electromagnetic waves within the material, amplifying multiple scattering and surface polarization effects, thereby increasing dielectric losses. Dielectric loss occurs when a portion of the electromagnetic wave's energy is converted into electric current as it passes through the material and is converted into heat due to the material's internal resistance (Xu et al., 2024).

In terms of magnetic losses, the ferromagnetic nature of Fe and Co elements, along with the ferromagnetic properties of the FeMnCo alloy (Sarı & Kırındı, 2011), can lead to hysteresis losses, magnetic resonance, and eddy current losses within the material (Erdem et al., 2025). In such materials exposed to a changing magnetic field, the constant realignment of the internal magnetic field to match the external field consumes energy; this energy loss leads to the conversion of electromagnetic waves into thermal energy, thus effective absorption (Xu et al., 2024). In conclusion, the superior EM wave absorption performance observed in FeMnCo doped PAN nanofiber can be explained by the synergistic effect of high impedance matching, multiple scattering effect, and combined dielectric–magnetic loss mechanisms. These findings suggest that metallic alloy reinforcement is an effective strategy to optimize EM wave absorption in nanofiber-based polymer composites.

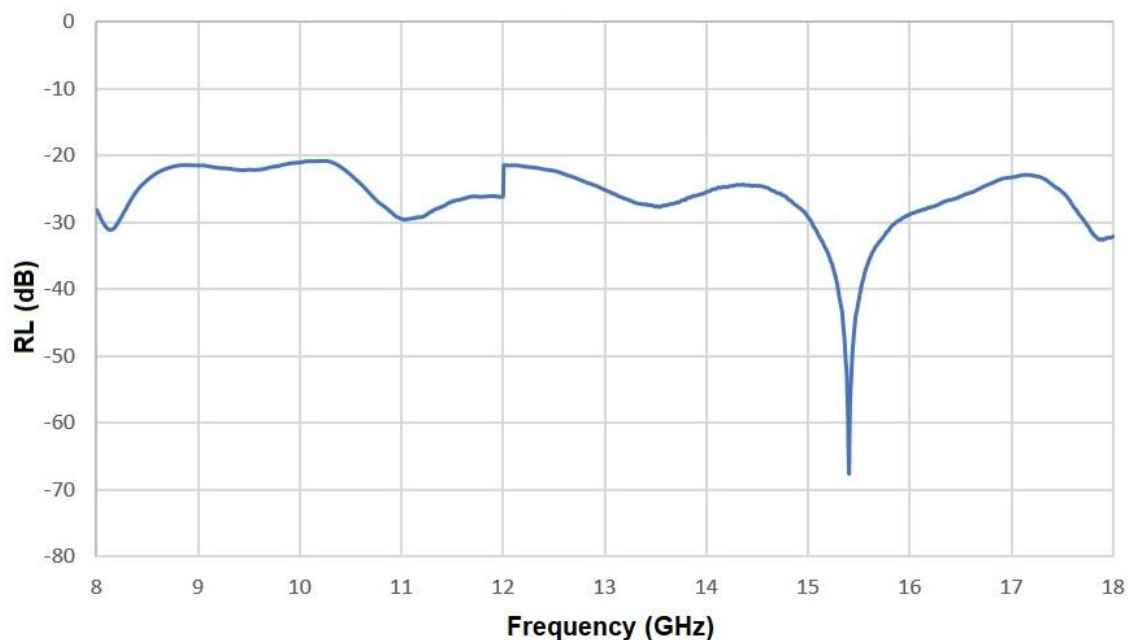


Figure 5. RL curve of FeMnCo-nanofiber in the 8–18 GHz range

Conclusion

In this study, the morphological, structural, and electromagnetic wave absorption properties of FeMnCo alloy-doped PAN nanofiber were systematically investigated. SEM analyses revealed that the electrospun nanofibers exhibited a thin diameter (200–400 nm), a high aspect-to-diameter ratio, and a three-dimensional network-like morphology. This morphology, thanks to the high specific surface area and multiple scattering mechanisms, allowed electromagnetic waves to travel longer distances within the material and increased energy losses. XRD results showed that the composite structure contained amorphous and semi-crystalline regions of PAN, as well as α' -martensite, γ -austenite, and ε -martensite phases of FeMnCo alloy. This microstructure is believed to enhance both the electrical conductivity and magnetic properties of the material, thereby enhancing its electromagnetic absorption capacity.

EM absorption performance evaluations revealed that FeMnCo-PAN nanofiber composites exhibit reflection loss values below -20 dB in the frequency range of 8–18 GHz and reach a maximum RL value of -67.59 dB at 15.40 GHz. These values demonstrate that the material can achieve highly efficient EM wave absorption in both the X and Ku bands. The superior performance achieved can be explained by the high impedance matching provided by the FeMnCo alloy doping, the multiple scattering effect caused by the conductive particles, and the synergistic effect of simultaneously activating dielectric–magnetic loss mechanisms.

In conclusion, FeMnCo-doped PAN nanofiber composite stand out as lightweight, flexible, and manufacturable materials that exhibit high electromagnetic wave absorption capacity over a wide frequency range. These properties give these composites a high potential for use in advanced technology applications such as electromagnetic interference shielding, radar absorbing surfaces, and wave absorption coatings.

Recommendations

To improve the electromagnetic absorption performance of FeMnCo-doped PAN nanofiber, the use of a high-efficiency homogenizer and controlled ball mill instead of a filing method and magnetic stirrer in alloy powder preparation is recommended. This approach can positively contribute to the electromagnetic properties of the material by reducing alloy particle size and improving homogeneous distribution. Furthermore, systematic optimization of FeMnCo ratios and fiber thickness, as well as layered integration of different dielectric and magnetic phases, may further enhance absorption performance. Thermal, humidity, and mechanical strength tests can be performed to assess the material's suitability for long-term use.

Scientific Ethics Declaration

*The authors declare that the scientific ethical and legal responsibility of this article published in EPSTEM journal belongs to the authors.

Conflict of Interest

*The authors declare that they have no conflicts of interest.

Funding

*This work was supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK, 2224-A, Project No: 1919B022502481).

Acknowledgements or Notes

*This article was presented as an oral presentation at the International Conference on Basic Sciences and Technology (www.icbast.net) held in Budapest/Hungary on August 28-31, 2025.

*The authors acknowledge the support of the Scientific and Technological Research Council of Türkiye for participation in the international scientific event.

References

- Abdalla, I., Cai, J., Lu, W., Yu, J., Li, Z., & Ding, B. (2023). Recent progress on electromagnetic wave absorption materials enabled by electrospun carbon nanofibers. *Carbon*, 118300.
- Bayat, M., Yang, H., Ko, F. K., Michelson, D., & Mei, A. (2014). Electromagnetic interference shielding effectiveness of hybrid multifunctional Fe₃O₄/carbon nanofiber composite. *Polymer*, 55(3), 936-943.
- Cai, W. J., Jiang, J. G., Zhang, Z. D., Liu, Z. X., Zhang, L. J., Long, Z. K., & Bi, K. (2024). Carbon nanofibers embedded with Fe-Co alloy nanoparticles via electrospinning as lightweight high-performance electromagnetic wave absorbers. *Rare Metals*, 43(6), 2769-2783.
- Dong, S., Li, J., Zhang, S., Li, N., Li, B., Zhang, Q., & Ge, L. (2022). Excellent microwave absorption performance of PAN-based Fe/C nanofibers with low loading fillers. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 655, 130280.
- Du, C., Zhang, Y., Wan, G., Wu, L., Li, L., Mou, P., Li, L., Xiong, H., & Wang, G. (2024). Multi-interfaced FeCoNi@C/carbon cloth composites for eliminating electromagnetic wave pollution. *DeCarbon*, 6, 100065.
- Huang, W., Tong, Z., Wang, R., Liao, Z., Bi, Y., Chen, Y., Wang, C., & Ma, Y. (2020). A review on electrospinning nanofibers in the field of microwave absorption. *Ceramics International*, 46(17), 26441-26453.
- Jia, Z., Lan, D., Lin, K., Qin, M., Kou, K., Wu, G., & Wu, H. (2018). Progress in low-frequency microwave absorbing materials. *Journal of Materials Science: Materials in Electronics*, 29, 17122-17136.
- Kahraman, H. T., Yar, A., Avci, A., & Pehlivan, E. (2018). Preparation of nanoclay incorporated PAN fibers by electrospinning technique and its application for oil and organic solvent absorption. *Separation Science and Technology*, 53(2), 303-311.
- Karbowniczek, J. E., Ura, D. P., & Stachewicz, U. (2022). Nanoparticles distribution and agglomeration analysis in electrospun fiber-based composites for desired mechanical performance of poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) scaffolds with hydroxyapatite (HA) and titanium dioxide (TiO₂) towards medical applications. *Composites Part B: Engineering*, 241, 110011.
- Kim, S. H., Lee, S. Y., Zhang, Y., Park, S. J., & Gu, J. (2023). Carbon-based radar absorbing materials toward stealth technologies. *Advanced Science*, 10(32), 2303104.
- Liao, Z., Ma, M., Bi, Y., Tong, Z., Chung, K. L., Li, Z., Wang, S., Yu, H., & Zhong, X. (2022). MoS₂ decorated on one-dimensional MgFe₂O₄/MgO/C composites for high-performance microwave absorption. *Journal of Colloid and Interface Science*, 606, 709-718.
- Li, L., Chen, Z., Pan, F., Guo, H., Wang, X., Cheng, J., Guo, Y., Zhang, X., Wang, Y., & Lu, W. (2023). Electrospinning technology on one-dimensional microwave absorbers: Fundamentals, current progress, and perspectives. *Chemical Engineering Journal*, 470, 144236.
- Liu, H., Li, Y., Yuan, M., Sun, G., Li, H., Ma, S., Gu, J., & Zhang, Y. (2018). In situ preparation of cobalt nanoparticles decorated in N-doped carbon nanofibers as excellent electromagnetic wave absorbers. *ACS Applied Materials & Interfaces*, 10(26), 22591-22601.
- Liu, T., Guo, Y. F., Yan, Y. M., Wang, F., Deng, C., Rooney, D., & Sun, K. N. (2016). CoO nanoparticles embedded in three-dimensional nitrogen/sulfur co-doped carbon nanofiber networks as a bifunctional catalyst for oxygen reduction/evolution reactions. *Carbon*, 106, 84-92.
- Pan, J., Guo, H., Wang, M., Yang, H., Hu, H., Liu, P., & Zhu, H. (2020). Shape anisotropic Fe₃O₄ nanotubes for efficient microwave absorption. *Nano Research*, 13, 621-629.
- Ruiz-Perez, F., López-Estrada, S. M., Tolentino-Hernández, R. V., & Caballero-Briones, F. (2022). Carbon-based radar absorbing materials: A critical review. *Journal of Science: Advanced Materials and Devices*, 7(3), 100454.
- Saeed, M., Haq, R. S. U., & Yi, J. (2024). Recent advances in carbon nanotubes, graphene and carbon fibers-based microwave absorbers. *Journal of Alloys and Compounds*, 5, 1-15.
- Xu, W., Liu, N., & Lu, Z. (2024). Recent progress of iron-based magnetic absorbers and its applications in elastomers: A review. *Materials*, 17(16), 4058.
- Wang, Y., Gao, X., Lin, C., Shi, L., Li, X., & Wu, G. (2019). Metal organic frameworks-derived Fe-Co nanoporous carbon/graphene composite as a high-performance electromagnetic wave absorber. *Journal of Alloys and Compounds*, 785, 765-773.
- Wang, F., Sun, Y., Li, D., Zhong, B., Wu, Z., Zuo, S., Yan, D., Zhuo, R., Feng, J., & Yan, P. (2018). Microwave absorption properties of 3D cross-linked Fe/C porous nanofibers prepared by electrospinning. *Carbon*, 134, 264-273.

Wang, Y., Wang, H., Ye, J., Shi, L., & Feng, X. (2020). Magnetic CoFe alloy@C nanocomposites derived from ZnCo-MOF for electromagnetic wave absorption. *Chemical Engineering Journal*, 383, 123096.

Author(s) Information

Kadir Asrin Sari

Özdemir Bayraktar Aerospace Technologies Vocational and
Technical Anatolian
High School, Ankara-Türkiye

Umit Erdem

Kırıkkale University, Vocational School,
Department of Electronics and Automation,
Kırıkkale-Türkiye

Uğur Sari

Kırıkkale University Science and Mathematics Education
Department,
Kırıkkale-Türkiye
Contact e-mail: usari05@yahoo.com

To cite this article:

Sari, K.A., Erdem, U., & Sari, U. (2025). Fabrication and characterization of FeMnCo/Nanofiber for radar absorbing material by electrospinning. *The Eurasia Proceedings of Science, Technology, Engineering and Mathematics (EPSTEM)*, 36, 39-47.