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Doctoral School on Materials Sciences and Technologies

Development of composite materials for the electromagnetic interference (EMI) shielding

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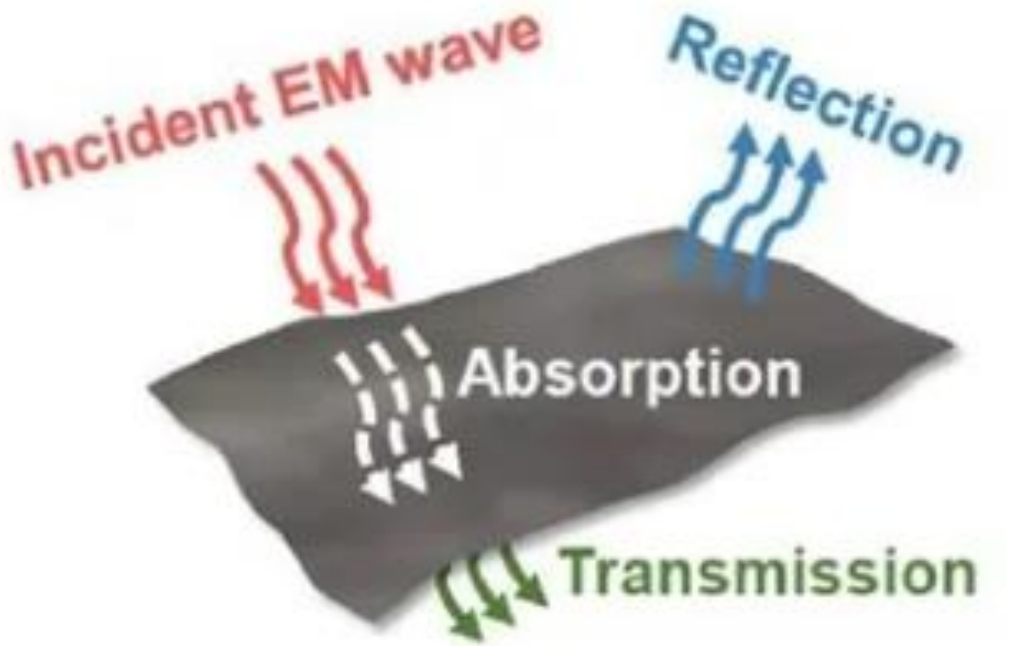
Introduction

- Electronic devices rely on clear signals. Shielding prevents outside electromagnetic waves from messing with these signals, ensuring devices work properly.

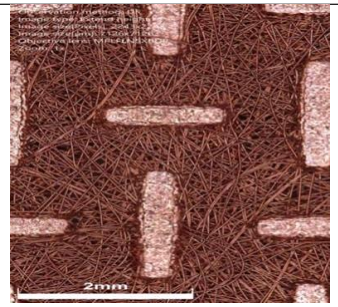


Experimental Setup

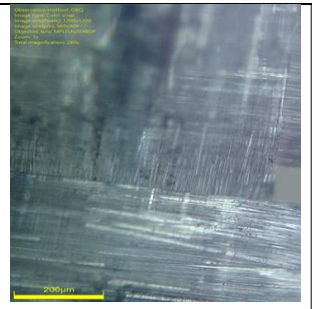
- Advanced Microwave Optics System (The frequency range for testing was set between 320MHz and 960MHz.)
- The Schwarzbeck USLP9143 log periodic antenna and the magnetic loop antenna. (The frequency is between 109 Hz and 3.1011 Hz)

Materials and Methods

a) Carbon fibres



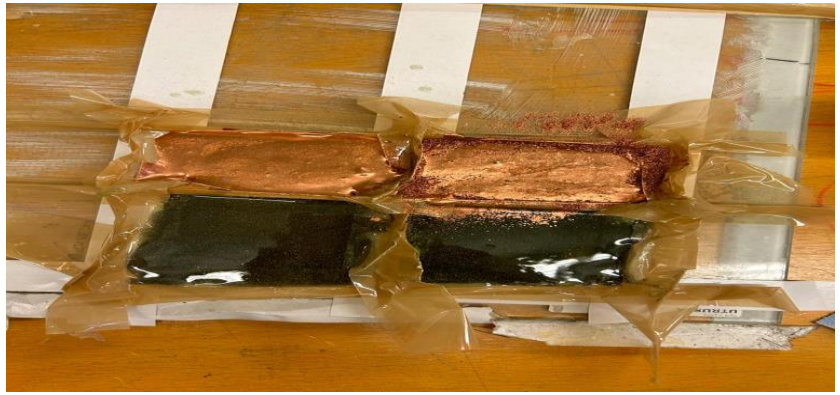
b)Copper fibers



c)Fiberglass coated by magnetic particles

Materials Used

- Powders: Copper, Titanium
- .Fibres: Carbon fibre, Fiberglass, Copper fibre.



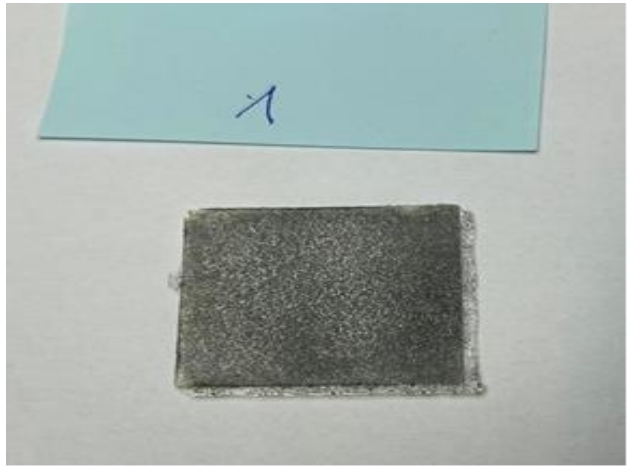
Composite Fabrication

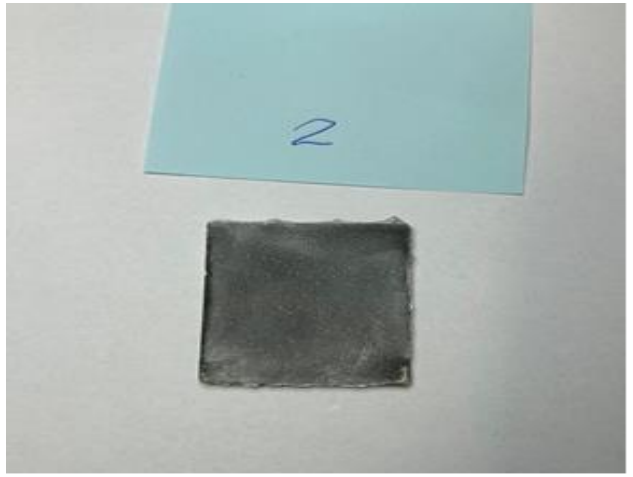
- Designing and 3D printing of molds
- Blending materials and filling molds
- Post-processing

Titanium and Polyester-Based Materials

To prepare the composite material, polyester was mixed with titanium powder in two different weight ratios.

Group	Titanium Weight (g)	Polyester Weight (g)	Density of Titanium (g/cm^3)
1	6	30	4.11
2	9	30	4.11

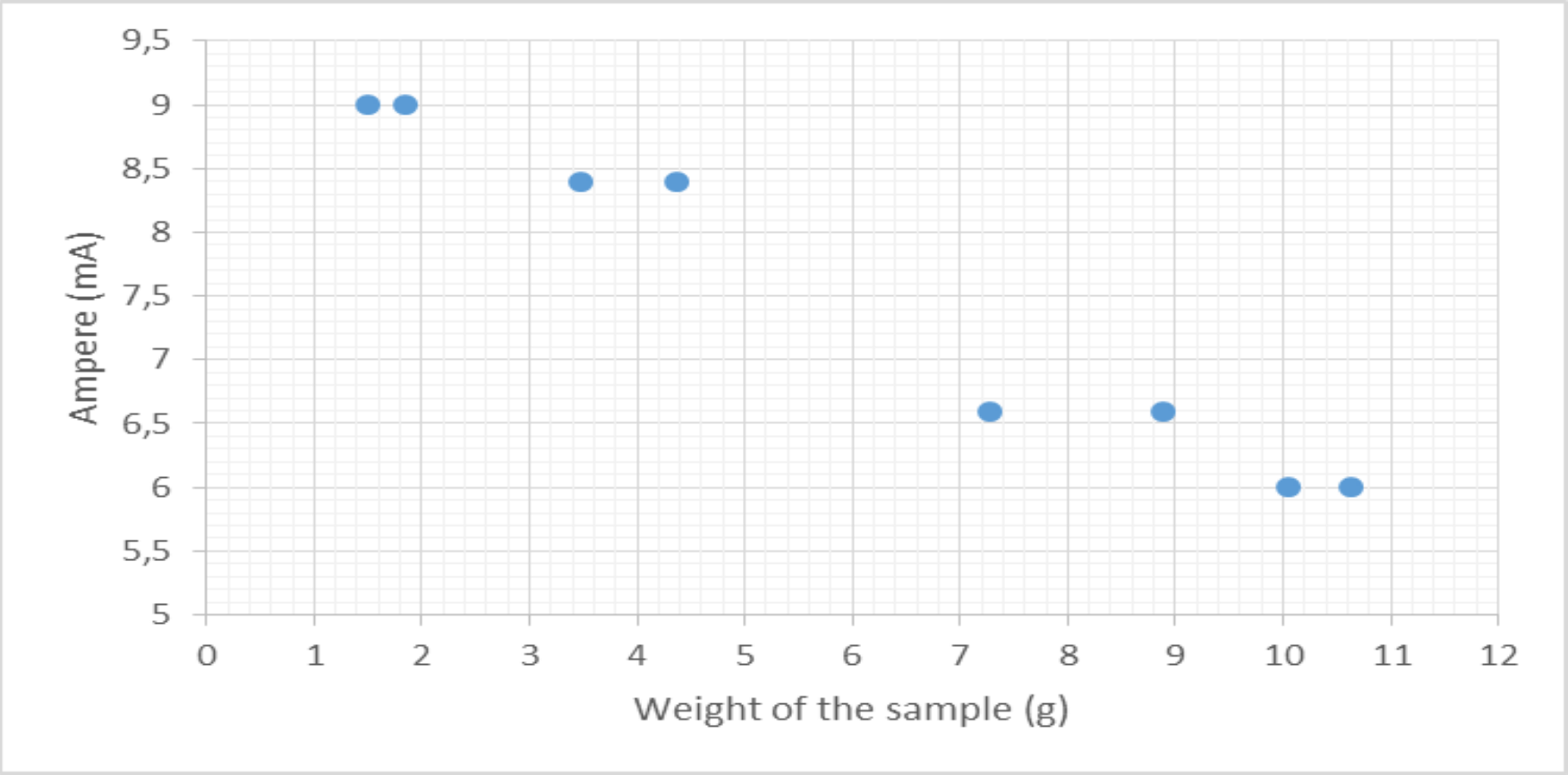




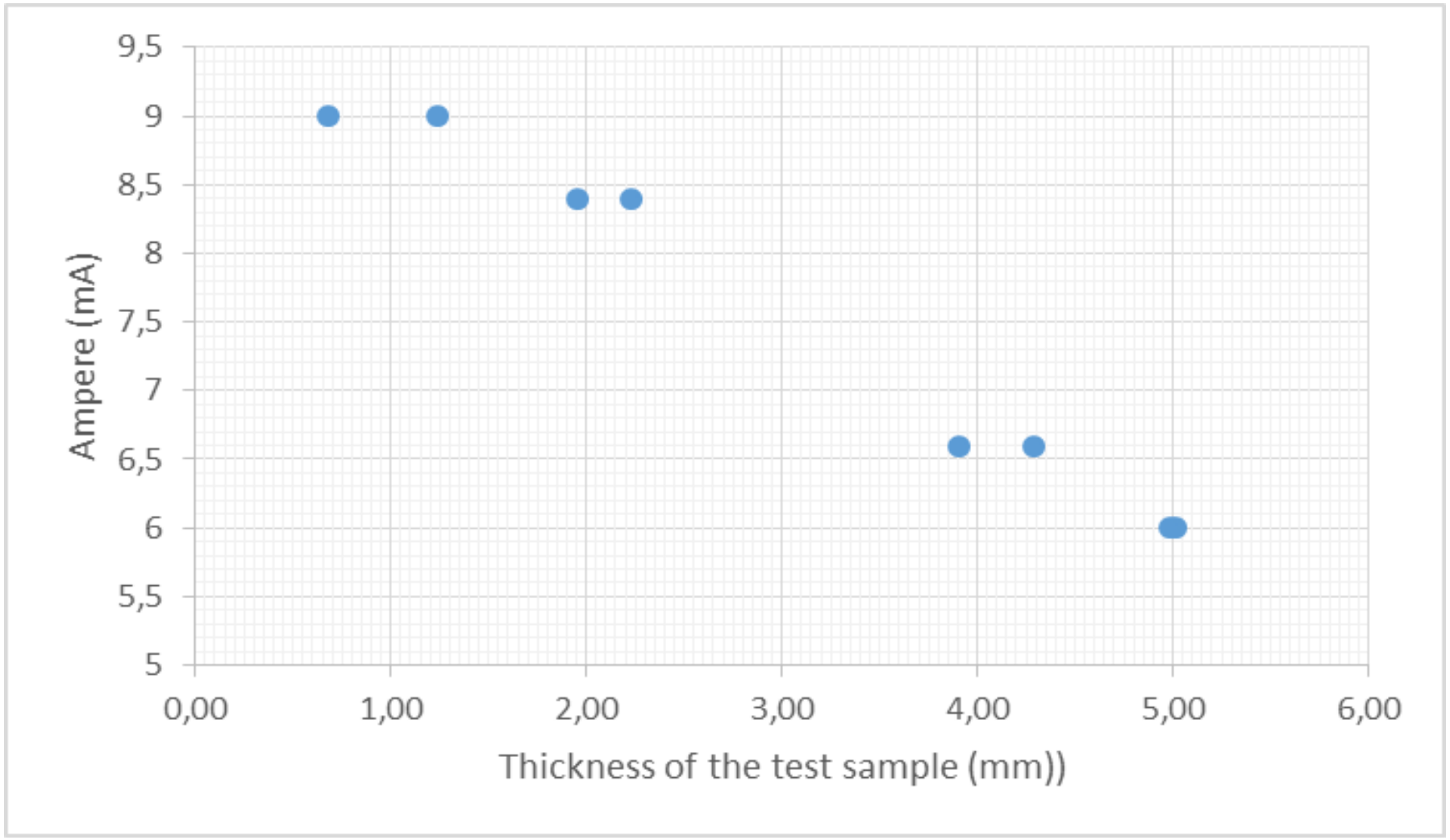
Results and Discussion

The sample	The thickness (mm)	The weight (g)	Measured Ampere (mA)
1	1.24	1.8518	9
2	2.23	4.3616	8,4
3	4.29	8.8940	6,6
4	5.01	10.6232	6
5	0.68	1.4922	9
6	1.95	3.4814	8,4
7	3.91	7.2748	6,6
8	4.98	10.0475	6

A test was made using the Tests with the Advanced Microwave Optics System



The measured ampere as a function of the test sample weight



The measured ampere as a function of the test sample thickness

PLA-based EMI shielding composite material

- PLA is a matrix material because of its biodegradability and mechanical properties. Therefore, to create a new material using PLA, a conductive filler is required to use this material in electromagnetic shielding applications

Conclusion

- The research studies the electromagnetic shielding properties of new composite materials using two different groups of materials.
- PLA served as the main matrix material and showed its promising role in environmental sustainability for advanced EMI shielding applications.
- Incorporating conductive powders into PLA, proved to have not only high shielding effectiveness but also a high environmental merit that underlined the possibility of reusing materials or circular application cycles.

Study Strategy for the Upcoming Semester

- Conduct an in-depth analysis of the PLA-based composite's EMI shielding effectiveness and structural integrity.
- Exploration of Alternative Materials
- Comprehensive Testing
- Collaborative Research
- Publication and Dissemination

Draft theses

1. The shielding composite EMI shielding efficiency depends on the metal quantity (e.g. thickness of the shielding plate).
2. The PLA – metal powder composite mechanical properties can increase by heat treatment.
3. The PLA – metal powder composite renewable material, it can recycle the metal powder after the PLA biodegradation.

Publications

1. **“A Comprehensive Review of EMI shielding materials”**

Authors: M. Shbanah, T.A. Kovács

Status: Pending review in Critical Infrastructure Protection: Advanced Technologies for Crisis Prevention and Response.

2. “The Effects of Electromagnetic Waves on Human Health”

Authors: M. Shbanah, T.A. Kovács

Published in Security-Related Advanced Technologies in Critical Infrastructure Protection: Theoretical and Practical Approach: Springer Netherlands, 2022. /**Q4**

3. “Developing a Mesh for Electromagnetic Shielding of Vehicles’ Electronic Devices”

Authors: M. Shbanah, T.A. Kovács, Z. Nyikes

Advanced Sciences and Technologies for Security Applications 2024 pp. 315-328. Paper: Chapter 28 , 14 p. (2024) / **Q4**

4. “The Effect of Heat Treatment on a 3D-Printed PLA Polymer’s Mechanical Properties”

Authors: M. Shbanah, M. Jordanov, Z. Nyikes, L. Tóth, T.A. Kovács

Published In: Polymers, 15 : 6 p. 1587 , 12 p. (2023) / **Q1**

Thanks for your kind attention