ÓBUDAI EGYETEM
ÓBUDA UNIVERSITY

Óbuda university
Doctoral School on Materials Sciences and Technologies

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

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Content

- Introduction
- Materials of the research
- Testing of EM
- Calculation of the weight
- Conclusions

Introduction

Designing an efficient shield for electromagnetic radiation means that the shield is good for magnetic fields and electric fields. IMPORTANCE and usability.

Reinforced Composite Materials

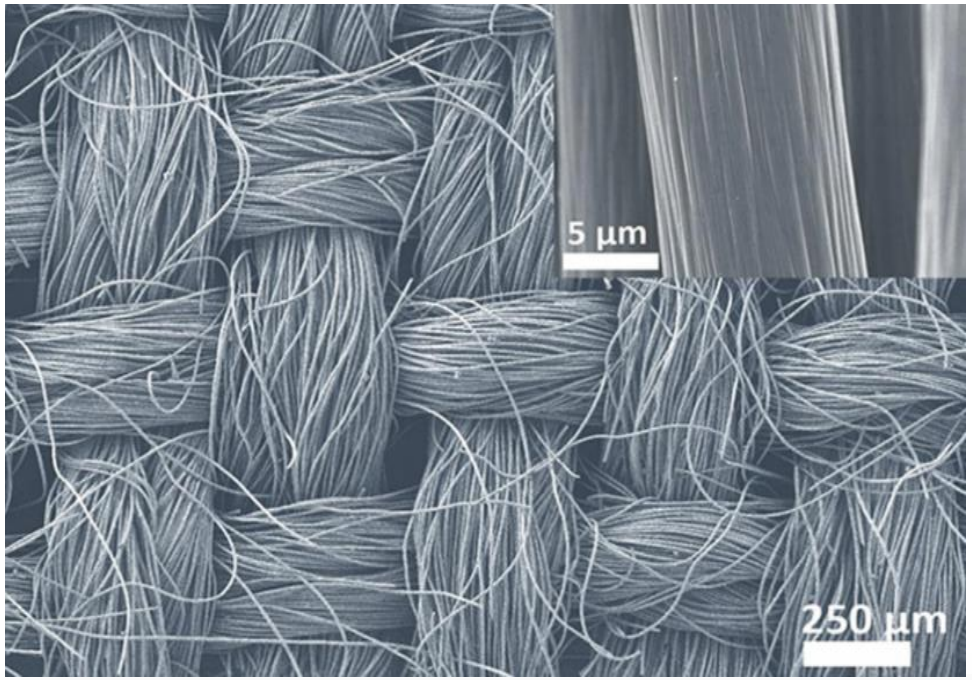
Thermoplastic Matrix + Fibers = Fiber Reinforced Thermoplastic Composite

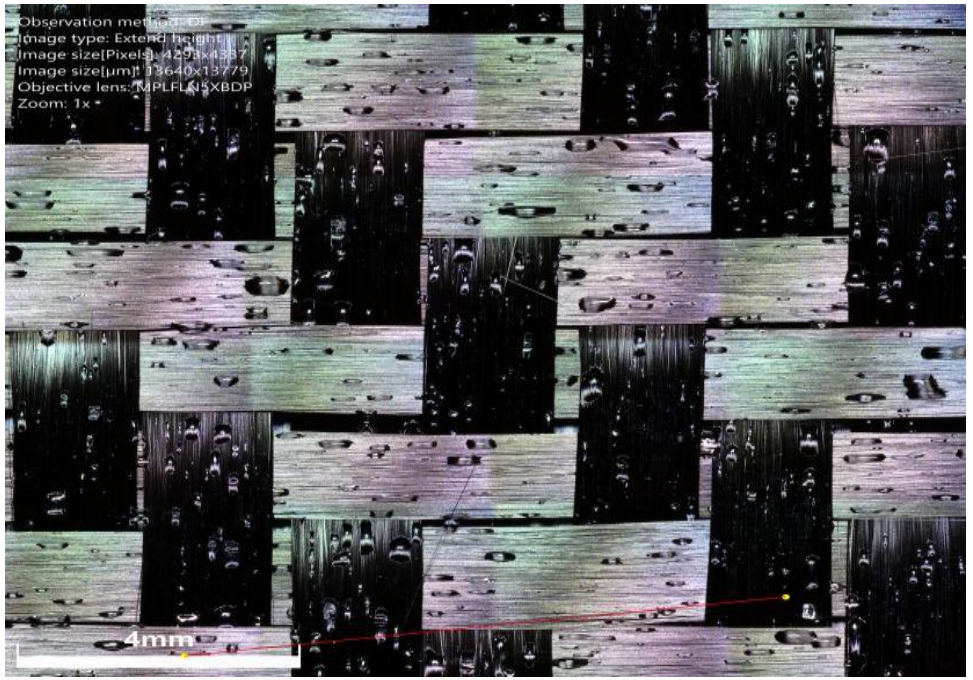
Carbon fibre

Copper mesh

Fibreglass

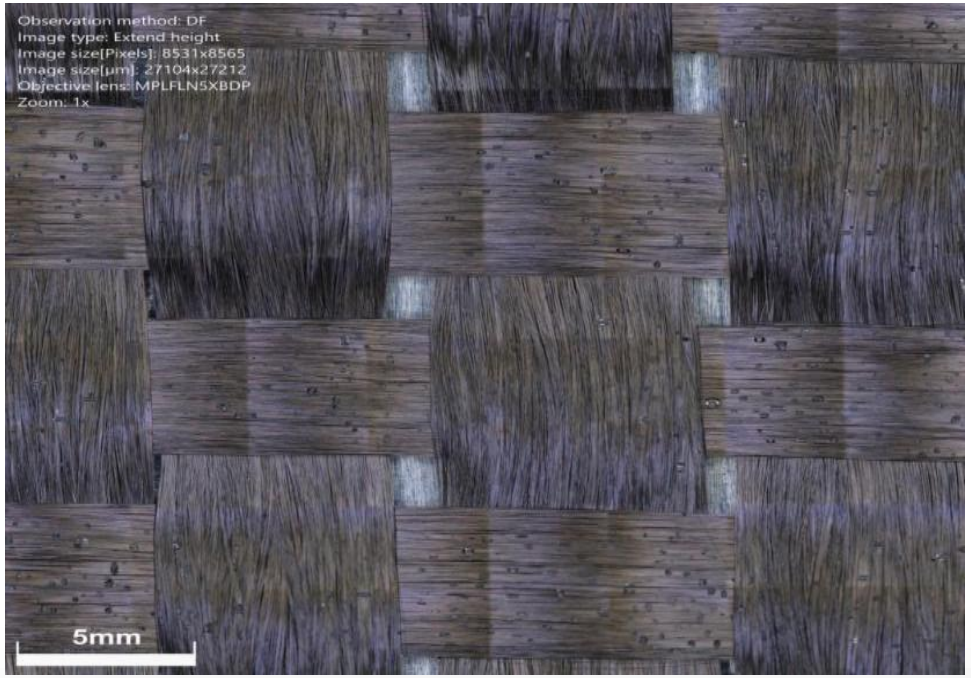
Carbon Fiber type 1





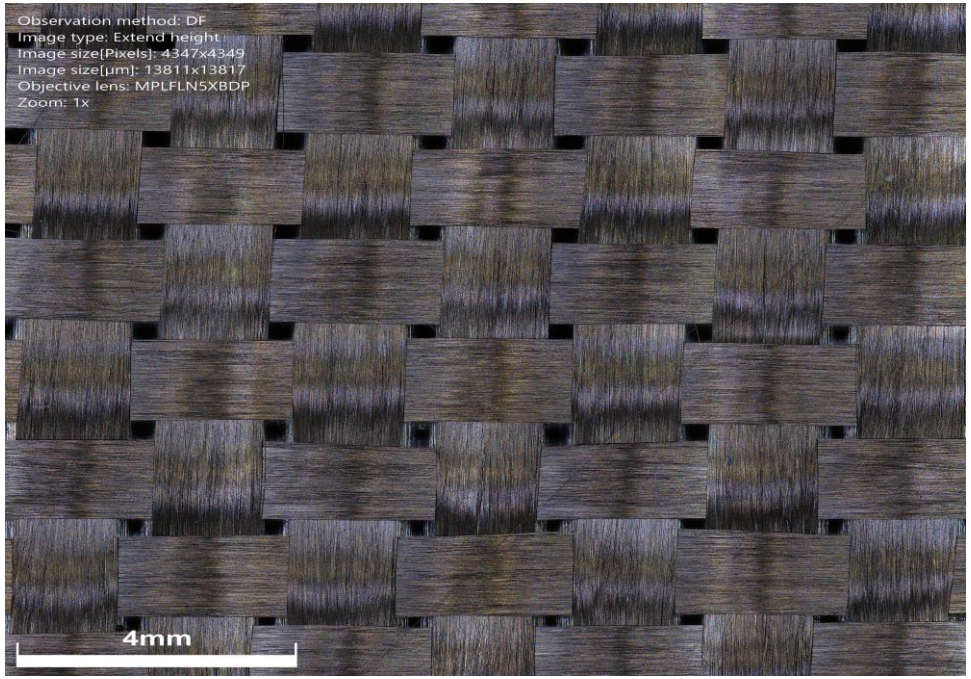
Permeability (H/m)	Relative permeability	Resistivity (Ωm)	Thickness (cm)	Weight (g)
0.05	39789	1	0.03	2.6052

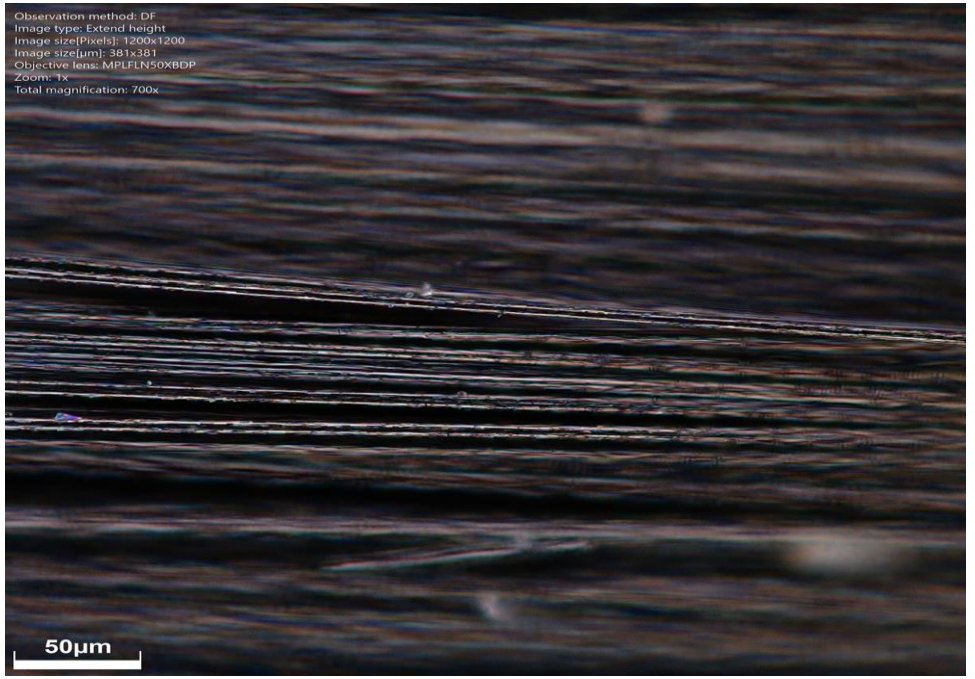
Carbon Fiber type 2



Permeability (H/m)	Relative permeability	Resistivity (Ωm)	Thickness (cm)	Weight (g)
0.04	31831	1.5	0.025	3.2659

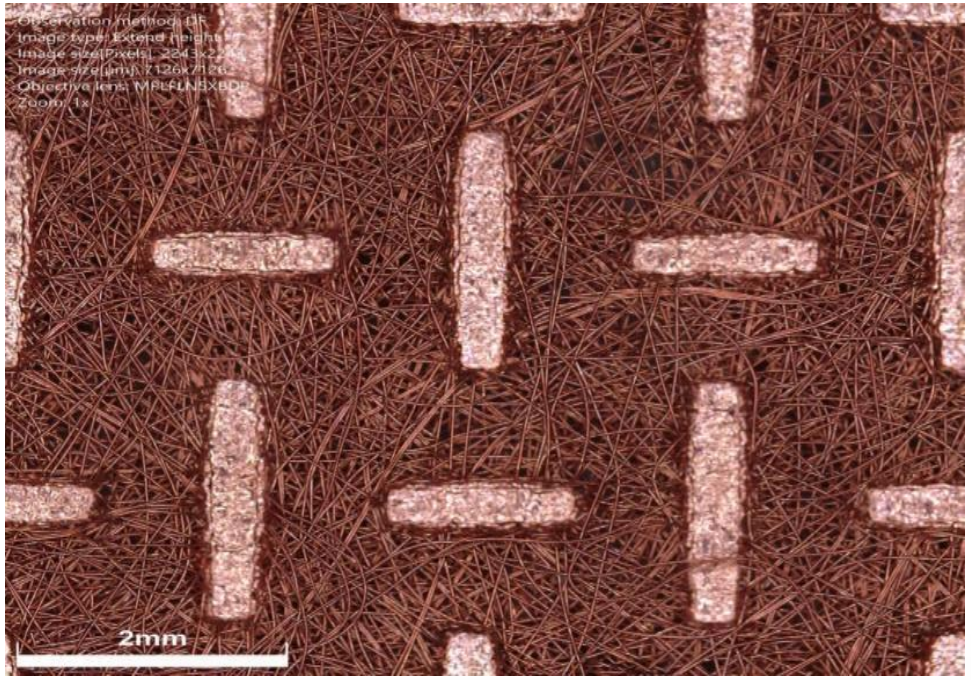
Carbon Fiber type 3

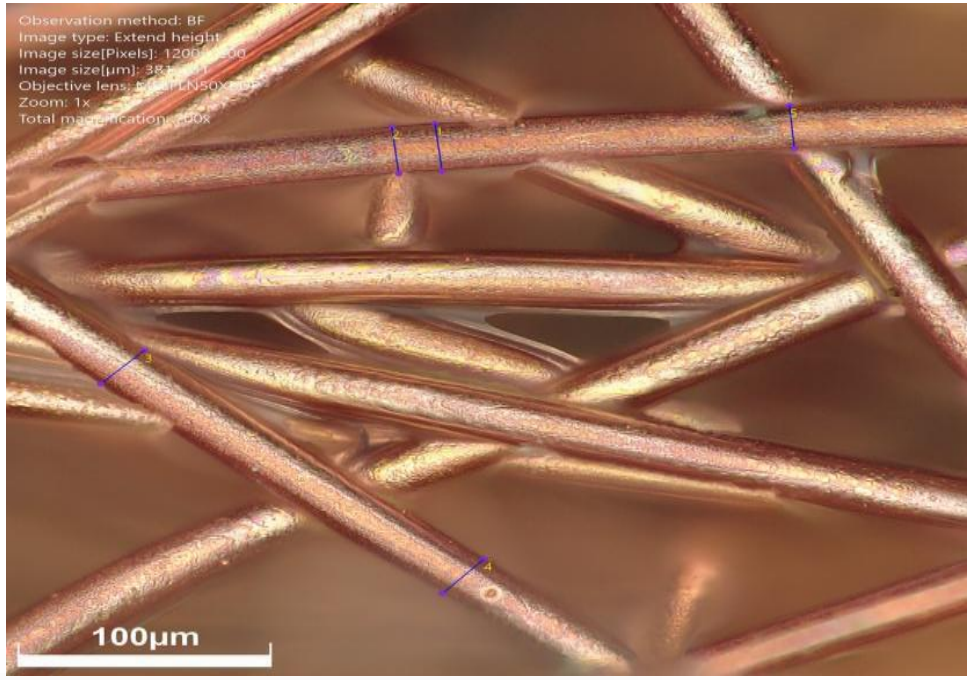




Permeability (H/m)	Relative permeability	Resistivity (Ωm)	Thickness (cm)	Weight (g)
0.045	35810	2	0.03	3.1778

Materials of the research





The density of the copper is 8.96 $^{g}/_{cm^3}$ whereas, the density of the tested copper mesh is 0.479 $^{g}/_{cm^3}$

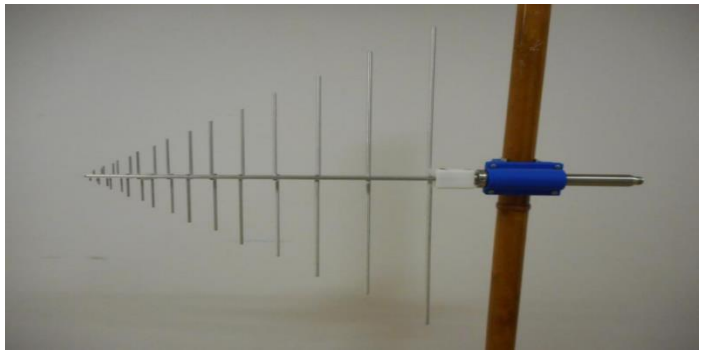
Permeability (H/m)	Relative permeability	Resistivity (Ωm)	Thickness (cm)	Weight (g)
1.2566×10^{-6}	0.999	$0.04*10^{-8}$	0.025	0.446

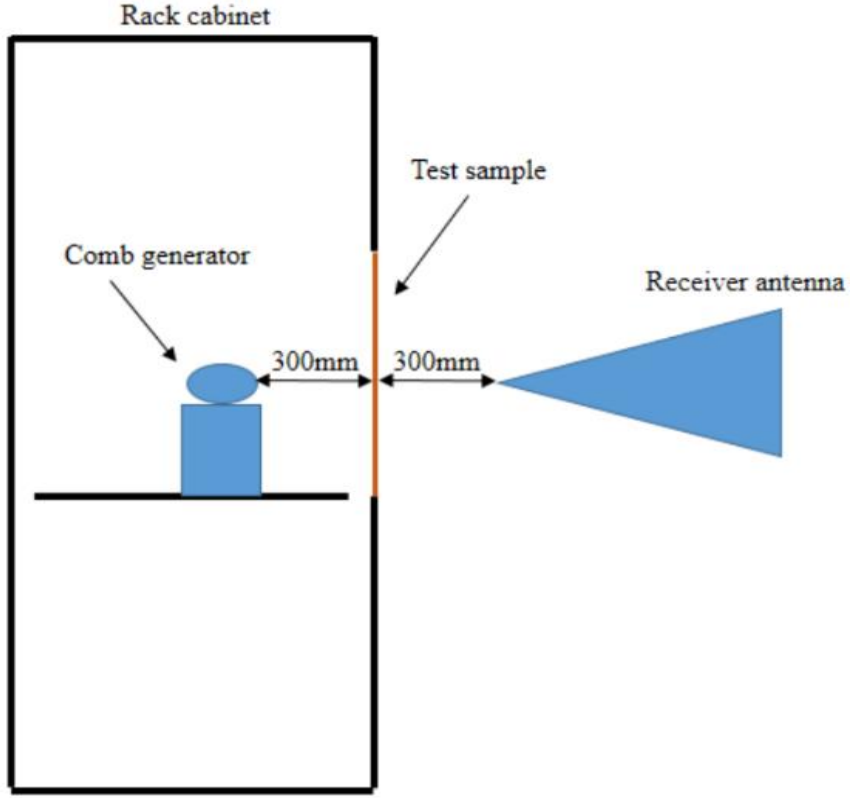
Fibreglass

Fibreglass is good reinforcing material for the composite material, but it is not good for electromagnetic shielding purposes

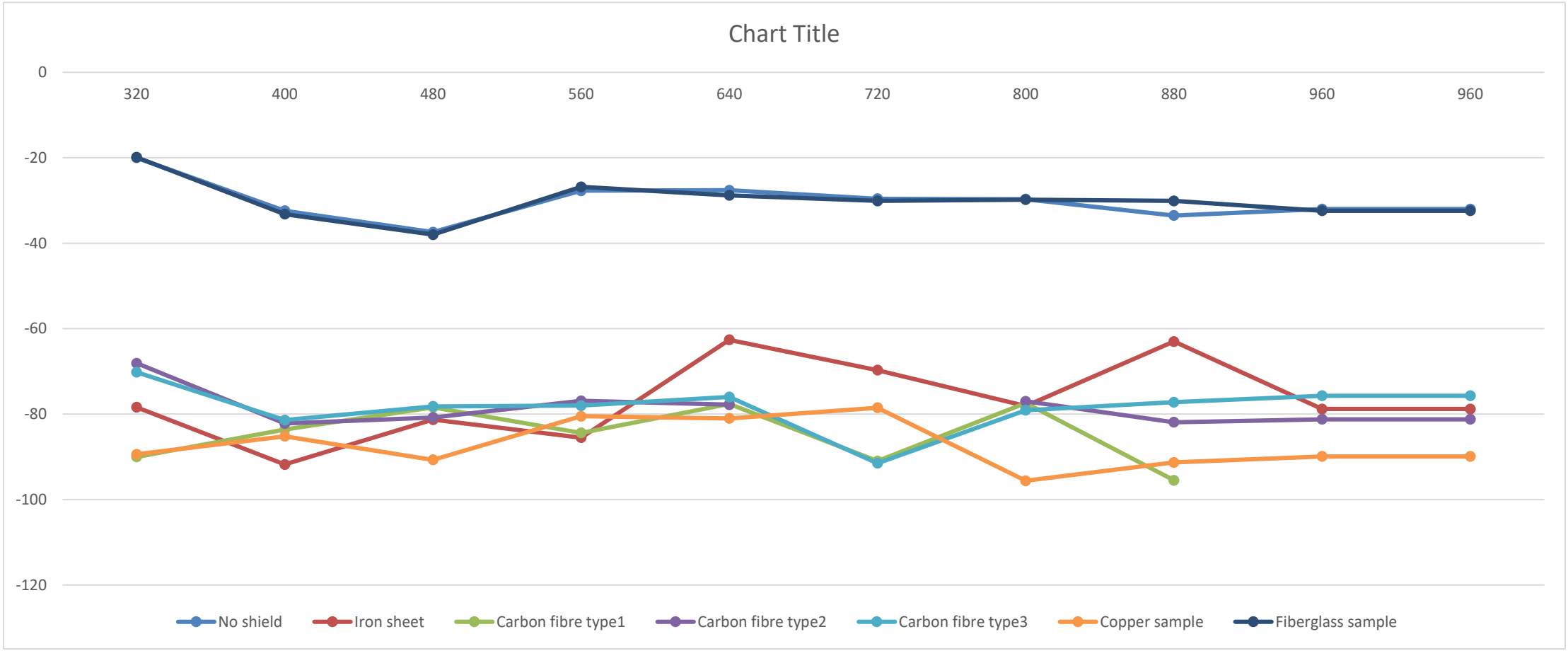
Testing method

- ✓ The electric (ER) and magnetic (MR) radiation measurements were performed in a noisy environment at different times of the day.

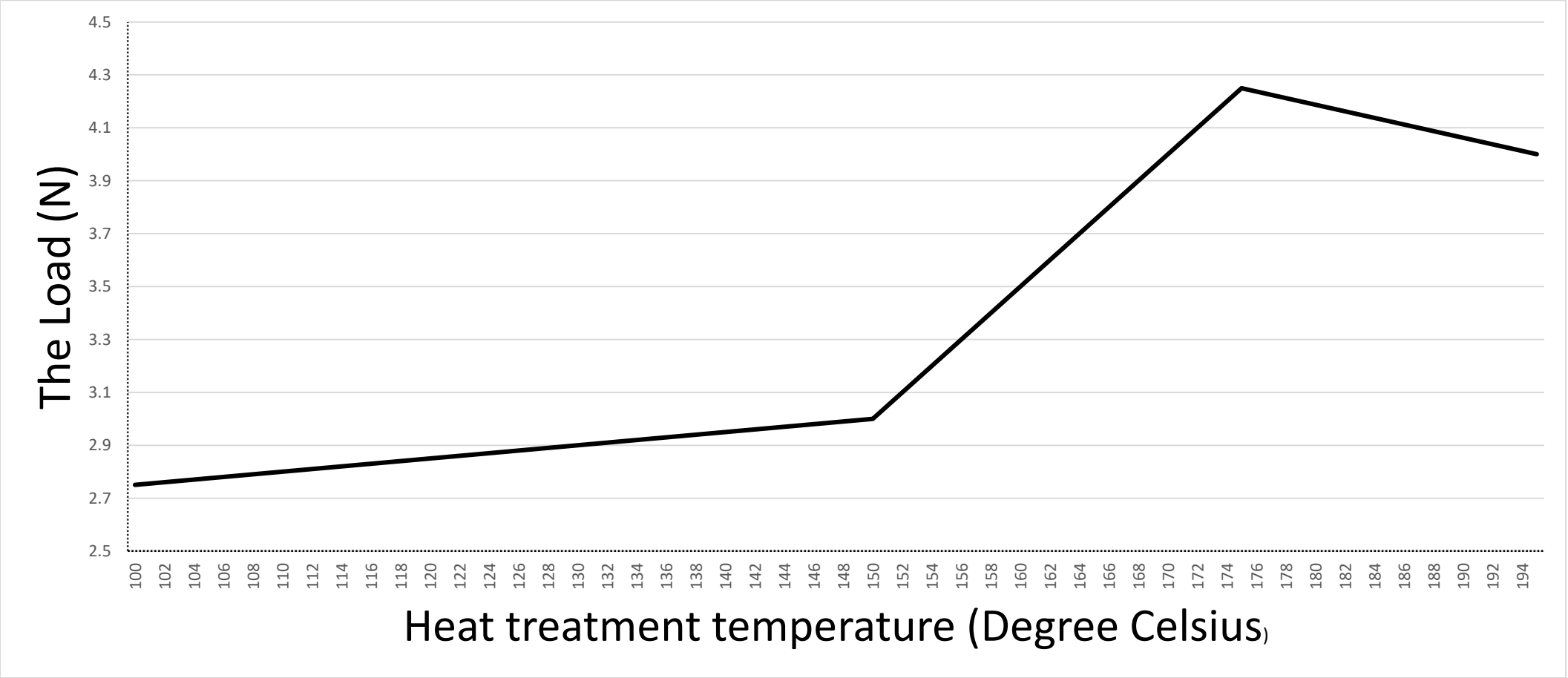




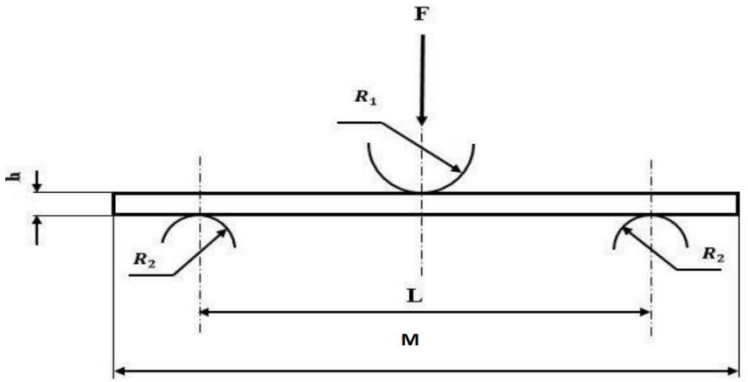
The graph of the electric radiation at vertical polarization/ results



The effect of heat treatment on the carbon fibre-reinforced polymer samples

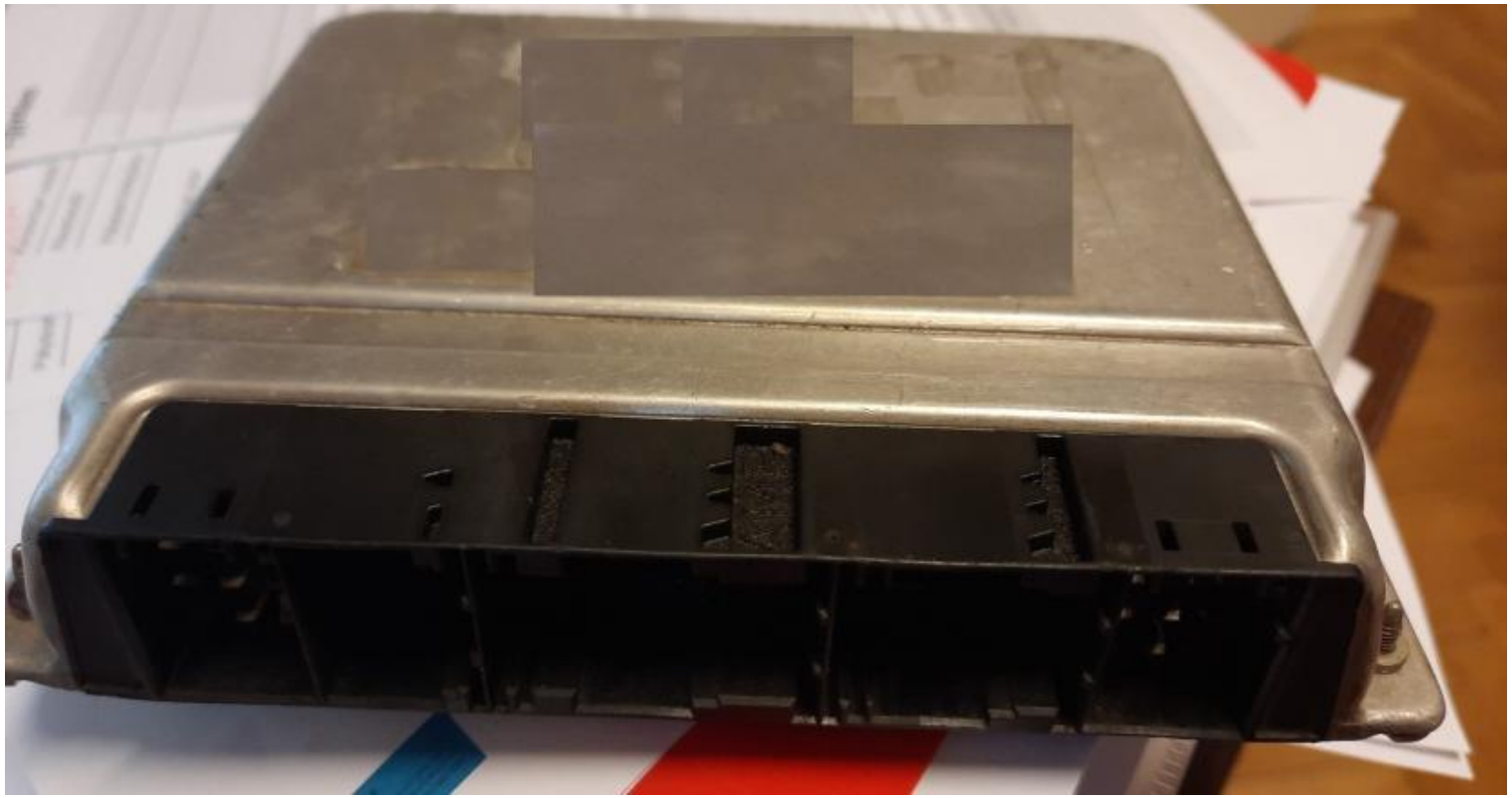


Bend testing



	M (mm)	b (mm)	h (mm)	F (N)	The heat treatment's temperature (°C)
The first specimen of carbon fiber-reinforced polymer	91.45	24.52	0.53	4	195
The second specimen of carbon fiber-reinforced polymer	91.77	24.96	0.46	4.25	175
The third specimen of carbon fiber-reinforced polymer	91.47	24.40	0.45	3	150
The fourth specimen of carbon fiber-reinforced polymer	91.65	24.85	0.40	2.75	100
The first specimen of the copper fibre-reinforced polymers	127.30	26.33	0.66	2.25	195
The second specimen of the copper fibre-reinforced polymers	127.11	24.37	0.68	2.25	195

Applications of the Research - Faraday cage



Calculation

Material	Thickness (mm)	Weight of 100 mm2 (g)	Tensile strength (Mpa)
Iron	3	23.622	540
Aluminium	0.16	0.27	90
Composite with copper	0.68	15.66	210
Composite with carbon	0.5	13.2	1400 to 4800

Conclusions

- The most effective material for electromagnetic shielding is carbon fibre for the range of frequency that I used and the second one is copper.
- Still, fibreglass was not effective for the range of frequency that I used to test the material, so fibreglass is good reinforcing material for the composite material, but it is not good for electromagnetic shielding purposes.
- About weight the iron and aluminium are have materials even the EMI shieldin properties are good.
- For Fraraday cage application the new composites are suitable.

Publications

- Shbanah, M., Kovács, T.A. (2022). The Effects of Electromagnetic Waves on Human Health. In: Kovács, T.A., Nyikes, Z., Fürstner, I. (eds) Security-Related Advanced Technologies in Critical Infrastructure Protection. NATO Science for Peace and Security Series C: Environmental Security. Springer, Dordrecht. https://doi.org/10.1007/978-94-024-2174-3_14
- Electromagnetic emission shielding for vehicles (pending)

Subjects fulfilled

Metal cutting theory

- Dr. Horváth Richárd

Fracture mechanics

- Dr. Kovács Tünde Anna

Future Plans

- Literature
- Developing a new material for electromagnetic shielding. this material will be light, cheap and easily processed.
- Improvement of the new material depending on its mechanical and shielding effectiveness properties
- Final testing of the new material and publishing of the results
- Conclusion
- Publications

Thank you