



POLYMER INSTITUTE
SLOVAK ACADEMY OF SCIENCES
Dúbravská cesta 9
842 36 BRATISLAVA
SLOVAK REPUBLIC

**Referee's comment of PhD thesis submitted by
Madina ABSHINOVA entitled "Electromagnetic properties of
polymers filled with functional fillers."**

Submitted PhD thesis of Madina Abshinova deals with the investigation of electromagnetic properties of polymeric composites where carbonyl iron (CI) is used as a filler of polyurethane and silicone elastomers. The correlation between electromagnetic properties of prepared composites and different types of CI, with spherical or flaky morphology, onion-like, partially disrupted onion, and polycrystalline microstructure was studied. Electromagnetic properties of prepared composites are investigated from various aspects, including basic characteristic of used CI and thermomagnetic stability of prepared composites. Stability of new kind of composite materials is crucial property for future application. The composites based on CI are interesting for materials science. The range of potential uses of CI as material with anticorrosion properties after coating with conducting polymers, and for processing of composites for electromagnetic wave absorbers, electromagnetic shielding, etc. is quite wide. From this point of view is the topic of PhD thesis actual and can bring new knowledge about studied systems.

Theoretical introduction of the work is written clear and provides the background of used iron materials, polymeric matrices, methods for investigation of composites properties, magnetic and dielectric spectroscopy, and also models for the explanation of magnetization mechanisms. The understanding of physical background of magnetic and dielectric properties of fillers and prepared composites is more than important. The author cited 60 original scientific papers publish predominantly in English language.

Some small mistakes and impreciseness appeared in submitted work.

- A. Pg. 25, Figs. 9 and 10. X-axis titles are missing.
- B. In the Introduction part some Figures captions do not contain information about polymeric matrix when composite properties are showing. (Figs. 4b, 10, 11, 16, etc.)
- C. Sometimes decimal numbers are writing using comma instead of point, as it is in Fig 13 in paper I, Table 2 in paper II, etc.
- D. I will appreciate to include Table with abbreviations using in thesis.
- E. Is caption of Fig. 6 in Paper I right?
- F. The term *Inflexion point temperature* used in Paper II for evaluation of thermal stability of composite samples is more known as $-T_{max}$.
- G. References 28 and 29 are missing in Paper II. (pg. II.14)

I have also some comments and question to submitted thesis.

1. The structure of CI particles plays important role for preparing composites with electromagnetic properties. Primary CI particles are characterized by onion-like structure of alternating layers of α -iron and cementite. Cementite is composed of iron carbide (Fe_3C) and iron nitrides (Fe_4N). Which from these two compounds, α -iron or cementite, create the last-outer layer of CI particle?
2. The complex permittivity measured in range from $-30\text{ }^\circ\text{C}$ to $150\text{ }^\circ\text{C}$ on frequency for silicone elastomer composites containing primary CI particles (type ES or KM) was found to be temperature independent. When processed CI particles (SL, and MCI) were used as filler sharp decrease of real and imaginary part of permittivity versus frequency was measured. Structural difference of the CI and higher stability of primary particles are considered as a main reason. It is possible that this effect is caused also by chemical interaction of matrix and processed CI fillers?
3. Paper III, page III.8. Thermal analysis of pristine and polyaniline coated CI particles. Explanation that lower oxidation of iron particles coated with polyaniline is due to gradually cross-linked polyaniline can be correct only up to temperature $400\text{ }^\circ\text{C}$, at higher temperature polyaniline decompose. Do you plan to use other type of analysis for detection of products during thermal treatment?

Conclusions

The aims of submitted PhD thesis have been accomplished. Electromagnetic properties of composites filled with various types of CI are determined by the microstructure of used filler. Study of thermomagnetic stability of composites together with various magnetization model analysis provided important information about the prepared materials.

From obtaining results three papers were publish or submitted to publication into international scientific journals with impact factors in the range from 1.7 to 2.2. Author of PhD thesis presented outcomes of her research also in various international conferences. Therefore, after answering questions and successful defence of the thesis, I recommend to award Madina Abshinova the degree

“Philosophiae doctor”.

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Mária Omastová, PhD
Polymer Institute, SAS, Bratislava
E-mail: upolmaom@savba.sk
Tel.: + 421-2-5477 3308
Fax: +421-2-5477 5923