

## Review of Doctoral Thesis

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Department of Ceramics, Glass and Cement

Title: **Preparation and properties of materials for intelligent systems**

Reviewer: prof. Ing. Jaromír Havlica, DrSc.

### General description

Presented dissertation thesis was focused on synthesis and characterization of stimulus responsive materials based on oligomers of conducting polymers which could be used as a dispersed phase in electrorheological fluids in order to enhance their performance.

The thesis consists of seven chapters:

1. ***Theoretical Background***, where general overview of smart fluids, rheological behavior of smart fluids, physical background of the electrorheological effect, composition of electrorheological fluids, factors influencing electrorheological effect (electric field strength, particle size and morphology, temperatures particle concentration), requirements on electrorheological fluids, shortcomings of electrorheological fluids, application of smart fluids resp. are discussed.
2. ***Motivation and aim of the doctoral study***
  - Preparation of new materials based on oligomers of conducting polymers which could be used as a dispersed phase in electrorheological fluids in order to enhance their performance
  - Investigation of possibility to use carbonization process as a new method for preparation of electrically polarizable particle for electrorheological fluids with enhanced electrorheological effect
  - Investigation of electrorheological parameters of prepared electrorheological fluids in absence and in presence of an external electric field.
3. ***Experimental*** part contains some references to the individual papers.
  - The work ***An Effect of carbonization on the electrorheology of poly (-'p-phenyldiamine)*** was in the temperature interval 200-600 ° C increasing of specific surface area during carbonization was observed. The Raman spectroscopy confirmed the transformation of ppPDA particles into nitrogen-enriched carbonaceous structure by an exhibition peaks which are typical for graphitic material. Carbonization was

found as progressive way for preparation of more effective substances for electrorheology applications.

- Next Paper : Carbonization of aniline oligomers to electrically polarizable particles and their use in electrorheology . In contrast to carbonization of ppPDA size of particle based on aniline oligomers results in larger dimensions during sintering at 650 °C, but cooling of products causes destruction of particles into sheets.
- Paper III Temperature-dependent electrorheological effect and its descriptions with respect to dielectric spectra. This samples were investigate in range from 25 up to 65 °C and electrorheological effect increased with increasing temperature.
- 4. Paper IV The observation of a conductivity threshold on the electrorheological effect of p-phenylenediamine oxidized with p-benzoquinone

#### 5. *The thesis contribution to the science*

6. **References.** The author has studied and used appropriate number of bibliography sources (106 articles and books) used and quoted in the thesis. It is the evidence of the deep theoretical knowledge and very good orientation in the problem discussed in the thesis.

7. **Appendices** contain submitted papers and personal data.

The thesis is written on 47 pages without submitted papers ( cca 40 pages). The structure of thesis conforms to principles and requests to the structure of scientific thesis. The word processing of the thesis is adequate. The thesis fulfills the formal requests on good level.

#### **The topicality of the thesis**

The author has performed good orientation and wide knowledge of different parts of materials science and manifested ability to solve questions important for development of progressive polymer materials

#### **Aims and methods of the thesis**

Objectives of the work have been focused on the electrorheological materials which are interesting from scientific point of view and have a application potential in various type of electrically controlled and driven processes. The procedures and the use of instrumentation contributed to achieving the goals of the work.

## Comments and Questions


1. If we apply to electrorheological fluid an electric field, leads to orientation of the chains in the direction of the electric field. Can you explain whether and how they will change the rheological properties of the fluid, if we change the direction of the velocity vector? Try you suggest some equation? You believe that it would be a technical application.
2. The work is primarily focused on the application of an electric field. Do you expect that it would be possible to deal with the evaluation of the magnetic field, for example, with ferrites?
3. Formation of molecular agglomerates may, when intensive electrical fields and high-speed transporting fluid cause the separation of these agglomerates in the fluid velocity field. Such phenomenon is described elsewhere in the literature?

## Conclusion

In my opinion, the thesis by Ing. Tomáš Plachý fulfills all the conditions for gaining the PhD. degree in Section of Chemistry and technology of materials.

**I recommend the thesis for defense and awarding by degree - PhD**

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