

Review Report on PhD Thesis of Ing. Karel Bernášek

entitled

“Applications of spectrally and spatially resolved NMR: induced anisotropy and phase transition in hydrogels; new relaxation probes for imaging”

supervised by doc. RNDr. Jan Lang, Ph.D.

The topic of the PhD thesis is relevant from the point of view of both the systems under study and the methods that were used to study these systems.

The PhD thesis is well structured and quite well presented. It consists of 7 main chapters. Lists of figures, tables and abbreviations are introduced.

A brief introduction to the NMR method is found in Chapter 1. The current state of knowledge of partial orientation in muscle tissue introduce in Chapter 2. A basic description of the orientation media used to introduce partial orientation and volumetric phase transition for PAM and PNIPAM is presented in Chapter 3. Sample preparation for partial orientation and volumetric phase transition is shown in Chapter 4. Measurements and results of partial orientation of carnosine are given in Chapter 5. The use of partial orientation for localized NMR measurement of the PAM bulk phase transition after acetone addition is described in Chapter 6. The MRI measurement with the new ^{19}F and IONP molecular probe is shown and discussed in Chapter 7.

The work contains a fairly extensive introductory part, which is important, however, seems to be too detailed. Otherwise, considering the research process and framework which author has chosen, the structure of the main part of the work is acceptable. Minor content inaccuracies do not affect the meaning of the work. The representativeness of the work could be higher if the graphics and pictures used from the literature were of better quality or if the abbreviations were deciphered at the first mention of them in the text.

I have only few objections:

1. The main disadvantage of this work, from my point of view, is the absence of a chapter about the goals of the thesis.

2. Some graphics (such as 6.6, 6.11, 6.12) miss the essential details in the description, which makes it difficult to understand.
3. On graph 6.12, the time scale (20 hours) is shorter than the stated equilibrium achievement (22 and 45 hours).
4. In chapter 6.6 the author writes “Observed dependence is interesting, but proper understanding requires separation of the interaction of water with polymer fibers and water with acetone and knowledge about hydrogel mechanical properties”. It is possible to separate the contribution of the mixed components by calculating the ratio of the NMR diffusion of the mixture to the pure components. Have any diffusion experiments or mechanical measurements been made for this system?
5. Chapter 7 lacks a detailed description of the systems that were used for the measurement. For example, there is no information whether all **IONPs** were coated with silica?
6. In the chapter **Conclusions**, part **Volume phase transition of hydrogels by MRI** the author writes “Large molecules, such as proteins, can be partially oriented in a stretched PAM and also PNIPAM”. But he does not specify the reasons for such an effect, and also does not explain which of the systems under study this statement refers to, with or without acetone.

Despite of above-given reservations, in my opinion, the author demonstrated the ability of independent creative work in the field and the reviewed thesis fulfills all requirements posed on theses aimed for obtaining Ph.D. degree.

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