Visit to: Lomonosov Moscow State University, Russia

Visit period: 17.09.2018-09.11.2018

Visitor: Dirk Romeis (IPF Dresden)

Host: Elena Kramarenko

In autumn 2018 I visited the group of Prof. Elena Kramarenko in Moscow. She is the head of the Chair of Polymer and Crystal Physics at the Lomonosov Moscow State University. Among other research fields the group intensively studies the material properties of magneto-active elastomers, both experimentally and theoretically. Within the SPP 1713 programme Prof. Kramarenko´s group is our international collaborator for project P3 performing experiments to validate our theoretical predictions for the effective deformation behavior of magneto-sensitive elastomer in external magnetic field. The aim of the visit was to get in touch with the experimental aspects and the measurable arrangements in more detail. Thereby, we intended to adopt the theoretical framework accordingly to allow for a meaningful comparison with the experiments. Furthermore, we aimed to develop a work basis for a joint scientific contribution, to discuss and learn from each other the different modeling strategies developed in both groups and finally to intensify the scientific exchange between our two groups in Moscow and Dresden.

Shortly after my arrival we agreed to systematically vary the geometrical shape of otherwise identical samples during the measurement and, thereby, to identify the role of the macroscopic sample shape on the magnetodeformation behavior. I was allowed to take part in experimental measurements and a fundamental discrepancy in theoretical models was realized. Upon describing macroscopically sized samples only the two limiting cases of very large or very small applied fields is assumed frequently in literature. Both limits display the advantage that the microscopic arrangement of magnetized particles and the change of the macroscopic sample shape upon deformation in external field can be described independently from each other and so reducing the computational effort considerably. Practically, this would also allow for a separate identification of both effects in experiment. In contrast, for experimentally relevant field strengths such a separation can not be justified and accounting for the full problem would clearly go beyond our simplified theoretical approach, since the calculations become computationally very elaborate. During my stay we could develop a theoretical approximation framework to deal with this problem. Suprisingly, upon testing the approach against more precise calculations for some selected arrangements the results seem to be greatly accurate. Furthermore, we realized that the approximation scheme can as well be used to extend the theoretical model towards more general sample geometries.

In the course of my visit I also had the opportunity to take part and give a talk at the VII Bakeyev Conference “Macromolecular Nanoobjects and Polymer Nanocomposites” near Moscow (7.-12.10.2018).

I want to thank Prof. Kramaranko and her group members for their kind hospitality and help during my stay in Moscow.