Phase diagram of Stockmayer polymers in bulk and near surfaces

Joan J. Cerdà*, Pedro A. Sánchez†, C. Holm‡, Tomàs Sintes
IFISC, Instituto de Física Interdisciplinar y Sistemas Complejos
CSIC-Universidad de las Islas Baleares 07122-Palma (Mallorca)

Artificial magnetic filaments can be obtained by mutually linking magnetic colloids to form a chain. These magnetic chains represent the equivalent to magnetic polymers but at supra-molecular scale. In difference to one-dimensional chemical magnetic polymers which only manifest their magnetic properties at $T < 100K$, magnetic filaments can retain their magnetism at room temperature and zero field.

In this contribution we present the results of our previous studies[1−3] on the equilibrium conformations of flexible and semiflexible magnetic filaments in different physical environments of relevance for forthcoming applications. In particular, we focus on the determination of the phase diagram at zero field for magnetic filaments which monomers exhibit short-range LJ attractive interactions (Stockmayer polymers, i.e. filaments in poor solvent conditions) in the limit of strong dilution, as well as filaments in good solvent conditions. We study the cases of magnetic chains in bulk (see figure 1) and near an attractive surface. We find that the phase diagrams of magnetic systems exhibit a rich variety of new phases when compared with non-magnetic chains in similar environments.

The emerging interest in this relatively novel field is due to the fact that magnetic filaments are very appealing from the technological point of view. They can be thought as improved substitutes of current ferrofluids, or as elements for magnetic memories, chemical and pressure nanosensors, micro-propellers, non-permanent photonic crystals, and generation of unique patterns able to provide watermarks to authenticate cards or other documents, to just mention a few.

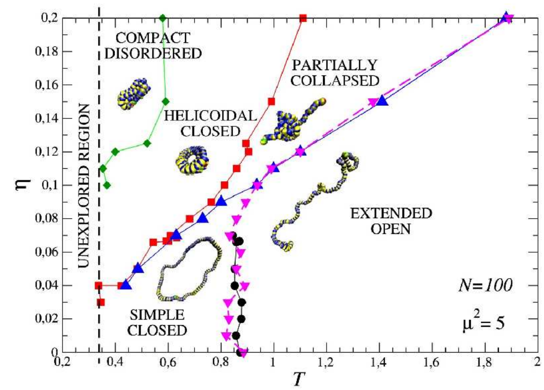

FIG. 1. A tentative phase diagram for magnetic filaments of length N=100, and a dipole moment per monomer of fixed strength $\mu^2 = 5$.

Acknowledgements: We thank the projects FISICOS (FIS2007-60327), GRID-CSIC and BwGrid founded by the Spanish MICNN and the ERDF, respectively.

* joan@ifisc.uib-csic.es
† Universität Wien, Computergestützte Physik, 1090 Wien, Boltzmanngasse 5.
‡ Institute for Computational Physics- ICP (Universtität Stuttgart), Stuttgart, Germany.

[1] J. J. Cerdà, P. A. Sánchez, C. Holm, T. Sintes, Soft Matter, *9*, 7185-7195, (2013).
[2] P. A. Sánchez, J. J.Cerdà, T. Sintes, C.Holm, J.Chem.Phys., *139*, 044904, (2013).
[3] P. A. Sánchez, K., J. J.Cerdà, V. Ballenegger, T. Sintes, C. Holm, Soft Matter, *7*, 1809, (2011).