NMR EXPERIMENTS ON BOVINE AND HUMAN CARTILAGE

Andrea Cretu[a], Oleg Petrov[b], Carlos Mattea[a] and Siegfried Stapf[a].

[a] Dept. of Technical Physics II, Technische Universität Ilmenau, Unterpörlitzer Straße 38, 98693 Germany
[b] Department of Low Temperature Physics, Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic

Cartilage is an essential part of the vertebrate body. It can be viewed as a fiber-reinforced, permeable composite gel within a physiological salt solution. The major fibrous component of cartilage, type II collagen, provides its tensile strength. Proteoglycan aggregates, found between the collagen fibers, generate a high osmotic pressure in the tissue. Osteoarthritis (OA) is a disease that affects the cartilage in joints, leading to pain, joint stiffness and loss of mobility [1]. Developing a method for the early detection of OA starts with understanding the healthy tissue and the effects of various treatments on its properties, as well as the investigation of ex-vivo specimens of healthy and diseased cartilage. Low-field NMR relaxometry provides a different perspective from the clinical MRI currently in use [2]. It offers information on the molecular dynamics inside the tissue. In the current work, bovine articular cartilage has been used as a model tissue to reveal the influence of drying (Fig. 1a), aging and trypsin treatement on the relaxation dispersion curves. The same technique has been applied on samples extracted from patients who underwent knee replacement surgery, revealing different characteristics of the dispersion curve depending on the severity of the disease (Fig. 1b). Histology and Mankin grading of these and future samples will allow a correlation between the properties of the relaxation dispersion and the severity of the disease.
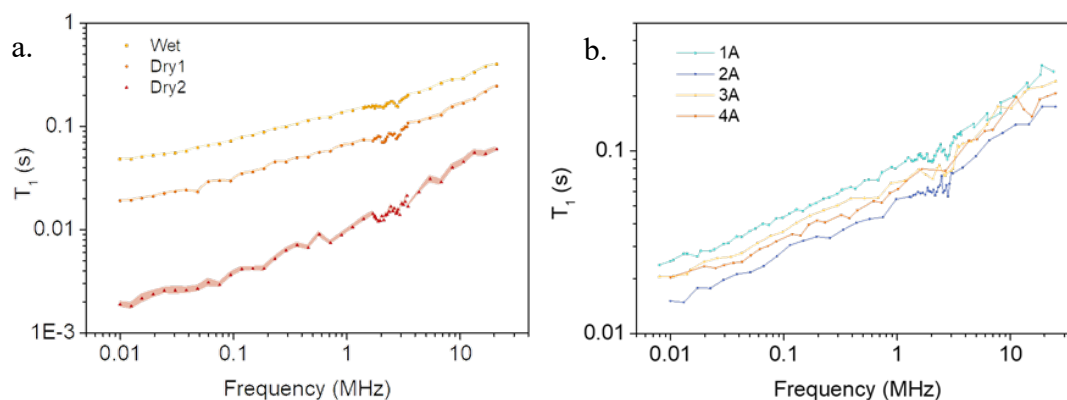

FIGURE 1. *a.* Dispersion curves of bovine cartilage undergoing drying, *b.* Dispersion curves for samples extracted from a human joint.

References
[1] Y. Xia, K. Momot, Biophysics and Biochemistry of Cartilage by NMR and MRI, The Royal Society of Chemistry, 2017.
[2] E. Rößler, C. Mattea, S. Stapf, S. Karhula, S. Saarakkala, M.T. Nieminen, Microporous Mesoporous Mater. 269 160–165 (2018).