# MM 54: Biomaterials and Biopolymers II (Joint CPP/BP/MM)

Time: Thursday 11:45–13:00 Location: H52

MM 54.1 Thu 11:45 H52

**Stimuli responsiveness of electron irradiated gelatin** — •Stefanie Riedel[1,2], Emilia I. Wisotzki[1,2], Katharina Apel[1], Wolfgang Knolle[1], and Stefan G. Mayr[1,2] — [1]Leibniz-Institut für Oberflächenmodifizierung, Leipzig — [2]Fakultät für Physik und Geowissenschaften, Universität Leipzig

Stimuli responsive materials have attracted considerable interest during the past years due to their potential use in sensor and actuator applications. They are designed to transform small external stimuli e.g. temperature and humidity changes into a significant response.

While a large number of alloys or synthetic polymers are well-established at this point, we explore the potential of the biomaterial gelatin to respond to humidity changes. We demonstrate how irradiation with high-energetic electrons allows fine-tuning of the response. In addition, this treatment enhances thermal stability providing high attractiveness for biomedical applications.

MM 54.2 Thu 12:00 H52

**Langzeitverhalten von Seide und "Selbstheilung"** — •Jan Rosigkeit[1], Igor Krasnov[1] und Martin Müller[1,2] — [1]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität Kiel — [2]Institut für Werkstoffforschung, Helmholtz-Zentrum Geesthacht

Durch Streckexperimente haben wir mechanische Eigenschaften des biologischen Nanokomposits Seide unter Verwendung eines Modells aus der linearen viskoelastischen Theorie [1] über lange Zeiten bestimmt. Wir stellen fest, dass sich die mechanischen Eigenschaften der Seide auf langen Zeiten "fraktional" viskoelastisch ("Memory"-Effekt) beschreiben lassen.

Seidenfasern können sich in zwei Zuständen befinden. Einer dieser Zustände ist ein stabiler Zustand der nicht vorgestreckten Faser. Der andere Zustand wird durch äußere Krafteinwirkung hervorgerufen, wodurch eine vorgestreckte Faser entsteht. Wir haben experimentell gezeigt, dass der Übergang vom vorgestreckten zum Anfangszustand in einer nassen Umgebung innerhalb von 24 Stunden stattfindet. Der vorgestreckte Zustand ist daher ein metastabiler Zustand. [2]

[1] W. Glöckle und T. Nonnenmacher, Macromol., **24:**6426-6434 (1991).

[2] J. Rosigkeit, Bachelorarbeit, Christian-Albrechts-Universität Kiel (2014).

MM 54.3 Thu 12:15 H52

**Fractional dynamics in silk** — •Igor Krasnov[1], Tilo Seydel[3], and Martin Müller[2] — [1]IEAP, Universität Kiel, Germany — [2]Institute of Materials Research, HZG, Germany — [3]ILL, Grenoble, France

Structural relaxations in humid silk fibers exposed to tensile stress have been observed to take place on a very wide range of time scales from a few milliseconds to several hours. The time-dependence of the measured tensile force following a quasi-instantaneously applied external strain on the fibers can be understood in terms of a fractional viscoelastic relaxation function introducing memory effects by which the mechanical state of a fiber depends on its tensile history. [1] An analog fractional relaxation also gives rise to the subdiffusion observed on picosecond time scales, which governs the mobility of the amorphous polymer chains and adsorbed water on the molecular level. The reduction of the subdiffusive memory effect in stretched fibers compared to native fibers is consistent with the higher order of the polymers in the stretched state.

[1] I. Krasnov, T. Seydel, and M. Müller, Phys. Rev. E 91, 042716 (2015)

MM 54.4 Thu 12:30 H52

**Mechanical properties of branched actin filaments** — •Mohammadhosein Razbin[1], Martin Falcke[3,4], Panayotis Benetatos[5], and Annette Zippelius[1,2] — [1]Georg August University — [2]Max Planck Institute for Dynamics and Selforganization — [3]Humboldt University — [4]Max Delbrueck Center for Molecular Medicine — [5]Kyungpook National University

Motile cells on a 2dimensional substrate generate motion by flat membrane protrusion called lamellipodia. Within lamellipodia, actin filaments are generated by branching off existing ones, giving rise to branched network structures. We investigate the force-extension relation of branched actin filaments, grafted on an elastic substrate at one end and pushing with the free ends against a flat and stiff wall. We compute the thermal fluctuation of the endpoints and the resulting entropic forces on a membrane, restricting the fluctuations of the endpoints. The entropic forces are shown to depend sensitively not only on the persistence length but also on the geometry of the structure. It depends on branch point position and filament orientation, being most pronounced for intermediate tilt angles and intermediate branch point positions. We describe filament networks without crosslinkers to focus on the effect of branching. We compare properties of branched and unbranched networks. The ratio of the network average of the force per branched filament to the average force per unbranched filament exhibits compression dependence and may go up to about 4.5 in networks with a narrow orientation distribution. With orientation distributions measured in lamellipodia, it is about 2.

MM 54.5 Thu 12:45 H52

**Tension, Balance and Flex: Auxetic periodic tensegrities** — •Myfanwy Evans — TU Berlin, Berlin, Germany

We present here a class of triply-periodic tensegrity structures that have a negative Poisson's ratio: they are auxetic. These theoretical materials are derived from periodic rod packings or more general periodic filament packings with a dilatant property. We show that these chiral tensegrity structures are periodically rigid but affinely flexible. The affine flex leads to isotropic expansion or contraction. A parallel can be drawn between these tensegrity structures and woven materials with elastic filaments, which also display an auxetic behaviour. Such materials are an exciting target for functional materials and biomaterials, from metal-organic frameworks to woven polymeric or filamentous structures.