BuildMoNa

UNIVERSITÄT LEIPZIG

SCIENTIFIC AND METHOD MODULES

Module name	**Multifunctional Scaffolds** Biopolymer Scaffolds to Study Dynamic Cell Function
Number	2015-T2
Aims	The basic background in passive and active soft matter physics will be taught to enable the students to use highly dynamic polymer scaffolds as an organising matrix for smart nanoelements and active proteins. A particular focus will be to build mechano-sensing, force-generating, moving, polymeric machines, inspired by active and passive biopolymer networks.
Basics	covered in basic modules B3 and B2 (polymer physics [viscoelasticity, statistical physics and thermodynamics of polymer chains], properties and isolation of biopolymers [DNA, actin, intermediate filaments, microtubule], Brownian motion, cell motility)
Contents	Physical concepts (statistical and polymer physics, nonlinear dynamics), biochemistry of protein filaments, Self-assembly and organisation (cytoskeleton and its architectures, asters and molecular motors, bead motility, counterion cloud condensation), Semiflexible polymers (individual filaments, entangled and cross-linked solutions, nematics, transients bonds, linear and nonlinear elastic as well as inelastic and plastic mechanics, active networks with molecular motors), From Brownian to directed motion (diffusion, thermal ratchets, entropic forces), Cell motility (forces, traction, mechanosensitivity), Bottom-up approach to cell mechanics (rheological properties, viscoelasticity, glassy behaviour, functional modules), Liquid crystal physics of lipid membranes (self-assembly, phase diagrams, vesicles, Langmuir monolayers, supported bilayers), Nanomuscles (active and passive filament bundles, contractile structures, bending stiffness).
Methods	Rheology (microrheology, plate rheometer, colloidal probe scanning microscopy, optical and magnetical tweezers, optical stretcher), microscopy (single molecule and particle imaging, digital polarization microscopy, confocal/multiphoton microscopy, STED, thermophoretic microscopy), Dielectric spectroscopy, Soft lithography and microfluidics, Theory and modelling (polymers in di-confinements effects, computer simulation methodologies for (semi)flexible polymers [chain-growth algorithms, Monte Carlo methods, scaling theories, etc.], Concepts from many-body physics to address entangled and cross-linked solutions, Active hydrodynamics.
Type	Two-day block course/ bi-yearly recurrence with modification
Date (month/year)	11/12 June 2015
Time	See page 2
Work load	15 hours presence/ 45 hours self-study
Examination	Written
Credit points	2
Responsible scientists	Pompe
International guest lecturers	M. Bailly (University College London / UK), K. Wolf (Radboud University Medical Center, Nijmegen, NL)
Industrial partners	
Recommendations for literature, e-learning	

Graduate School BuildMoNa
Universität Leipzig
Johannisallee 29
04103 Leipzig
Germany

Phone: +49 341 97-36015
Fax: +49 341 97-36017

buildmona@uni-leipzig.de
www.buildmona.de

SCHEDULE for Module 2015-T2

Time	Lecturer	Programme	Location
Day 1			
11 June 2015		**Scaffolds**	Linnestr. 3, room 204
9:30-10.45	T. Pompe Uni Leipzig	3D biomimetic matrices from natural biopolymers	
11:00-12-15	M. Hacker Uni Leipzig	Functional tissue engineering scaffolds from macromolecular building blocks	
14:00-15:15	U. Freudenberg IPF Dresden	Cell-instructive starPEG-GAG hydrogels: I Network properties	
15:30-16:45	U. Freudenberg IPF Dresden	Cell-instructive starPEG-GAG hydrogels: II Cell-matrix interactions	
Day 2			
12 June 2015		**Cell Function**	Linnestr. 3, room 204
9:30-10:45	M. Bailly UCL, London/UK	Modeling tissue contraction and fibrosis: cellular, mechanical and biochemical components regulating fibroblast behaviour in 3D matrices	
11:00-12:15	K. Wolf RUMC, Nijmegen/NL	Physical extracellular matrix determinants for the tuning of cell migration	
14:00-15:15	K. Wolf RUMC, Nijmegen/NL	Mechanisms of cell migration in vitro and in vivo	
15:30-16:45	J. Galle Uni Leipzig	Computer models of tissue formation on artificial substrates	

Didactic elements:
Lecture, discussions

Expected performance:
Active participation in discussions