synthetic cells. Here, we take the first step towards such bio-opto-fluidic systems by constructing a hybrid device that consists of soft materials, synthetic bacteria, fluidic systems and electronics. Specifically our device consists of a flexible polydimethylsiloxane (PDMS) chamber for culturing synthetic Escherichia coli that express green fluorescent proteins (GFP) and a flexible electronic layer housing an LED with an emission spectrum peak at 395 nm. The PDMS chamber has high gas permeability that facilitates aerobic cell growth conditions, high translucence that allows for optical control of the synthetic bacteria, and high viscoelasticity that provides mechanical versatility. We demonstrated that the synthetically modified bacteria can be excited internally by an electronic component without sacrificing the flexibility and transparency of the device. We have also shown that isopropyl β-D-1-thiogalactopyranoside (IPTG) can be delivered via micro channels over a flexible micro-porous PDMS membrane to modulate gene expression of the synthetically modified bacteria inside the device. Furthermore we optimized the geometry of the device with respect to bacterial growth rates, fluorescence expression, and fluid flow properties. Finally, we tested the device during mechanical deformation by bending to demonstrate the robust function of the device in strain-induced conditions. Our work will have wide impact on the development of the next-generation bio-opto-fluidic devices and the integration of synthetic biological systems with soft electronic materials.

3124-Pos Board B816

Shape Evolution of Multicellular Systems; Application to Tissue Engineering

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Organs are in high demand. Tissue engineering and regenerative medicine might be the answer to this challenge of the 21st century. Towards this goal our objective is to optimize the conditions for cells to self assemble into functional structures, such as tissues and eventually organoids. To facilitate self-assembly we employ the technology of bioprinting. To maintain the extended cellular assemblies, they need to be vascularized. Thus we first concentrate on the fabrication of blood vessels. We prepare convenient bioink particles, multicellular units composed of the relevant cell types and we deposit them into a geometry, consistent with the shape of the vessels. Self-assembly and the maturation of the construct takes place post-printing in special-purpose bioreactors by the fusion of the bioink units and the rearrangement of the cells within them. The time to achieve near physiological biomechanical properties has so far been found by trial and error. We have developed an experimental-theoretical-computational framework to optimize the postprinting maturation process, in particular the fusion of the bioink units. This paper focuses on the experimental component of this formalism, in particular on the fusion of spherical and cylindrical bioink units. The connection between experiments and computer simulations are guided by theory. Here we report the results of extended fusion experiments and on their comparison with predictions of the theory. The excellent agreement we find, on one hand, provides a verification of the theoretical component of the formalism, and, on the other hand, the input for the computational component of the formalism. Specifically, our experiments, together with the theory, allow the calibration of the basic simulation parameters, which in turn allows to fully implement the computational component of the formalism to optimize the fabrication of blood vessels through the bioprinting process.

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Development of a Liquid Formulation for Proteins for Long Time Storage

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Appropriate protein storage conditions are of interest for industrial biotechnology and an integral part to design sustainable biotechnological processes [1]. The molecular mechanisms need to be identified, that throughout the protein lifetime trigger possible but unwanted inactivation [2]. We developed a protocol here fore and discuss it on two systems:
The conformational stability of bovine serum albumin (BSA) in solutions of different concentrations of ammonium sulfate was monitored in respect to thermal stabilty by differential scanning calorimetry (DSC), change of secondary structure was analyzed by attenuated total reflectance Fourier-transformation-infrared spectroscopy (ATR-FTIR) and conformational changes upon different ionic strengths were imaged by small-angle X-ray scattering (SAXS). In the second example we discuss the evaluation of the optimal formulation for 8 monoclonal immunoglobulin (IgMs). These were differentiated by DSC and SAXS. Optimized formulations prevented aggregation and fragmentation from shear stress, freeze-thaw cycles, accelerated storage and real time storage at 4°C and −20°C and also preserved immuno reactivity for 12 months. Highest conformational stability was characterized by SAXS. In particular the molecular mechanism for both systems were analyzed and a consistent picture developed, that explain the cause for stabilization. SAXS data indicate decoration of specific domains for both proteins. Mean forces calculated point towards a compaction of the proteins and their stabilization.

[1] Monika Mueller, Maybelle Q. T. Loh, Doris H. Y. Tee, Yuansheng Yang and Alois Jungbauer (2013) Liquid Formulations for Long-Term Storage of Monoclonal IgGs. Applied Biochemistry and Biotechnology 169(4):1431-1448.
[2] Rupert Tscheliesssnig, Alois Jungbauer, Rene Ueberbacher and Herwig Peterlik (2013) Protein stability at high kosmotropic salt level.
submitted to Journal of Chemical Physics B.

3126-Pos Board B818

An On-Chip Pcr Approach Enabling Cancer Diagnosis

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The development of microfluidic platforms broke the barrier for rampant growth of on-chip biomarker identification in the field of disease diagnostics. Unfortunately, the amplification of nucleic acids directly from raw patient blood has yet to find a simple but complete design on a point-of-care microfluidic device. Here we report a technological approach to detect circulating DNA typically found in whole blood of cancer patients through an on-chip blood-plasma separation, filtration, reagent mixing, and PCR amplification. Raw patient sample blood will first be placed through a self-driven, gravitational and drag powered filtration system, where separation times as low as 10 minutes per 5 μL of blood can be achieved. Plasma separation coupled with nitrocellulose filters will lead to a 99% pure plasma product. Patient plasma can then be properly placed into micro-chambers, where they will be exposed to corresponding lyophilized reagents and enzymes. With each well equipped to an individual micro-heater, concentrated thermo-cycling induces DNA amplification by following golden-standard PCR methodology on a minute-scale basis. Amplification of nucleic acids in the steps indicated above present a simple device design for diagnosis of DNA biomarkers from patient to PCR. To thoroughly accomplish all desired tasks in a direct and efficient manner, the components of an on-chip PCR platform will include a simple yet powerful blood separation method, lyophilized reagent storage, and micro-heated thermo-cycling.

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Lipid Crystals Mechanically Stimulate Adjacent Extracellular Matrix in Advanced Atherosclerotic Plaques

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Although lipid crystals have received attention as a causative factor of plaque rupture, the mechanisms by which they increase plaque vulnerability have not yet been elucidated. We sought to examine whether solid-state lipid crystals mechanically affect the adjacent extracellular matrix (ECM) using multimodal nonlinear optical (MNLO) imaging. Through microanatomic visualization using MNLO imaging, we found that the internal elastic lamina was structurally changed; the size of fenestrae was increased in the transverse direction from lipid crystals. The level of elastin was also increased at the peripheral regions of lipid crystals. To investigate the influencing factors of this elastin increase, MNLO images were subjected to finite element analysis (FEA). The mechanical property of cholesterol crystals, experimentally measured using nanoindentation, was applied for FEA. We found that microscopic focal stress increased specifically around the lipid crystals corresponding to areas of increased elastin. Additionally, FE simulation was validated through a comparison to ex-vivo tissue stretching experiment to increase the reliability. These data suggest that lipid crystals may mechanically stimulate the adjacent ECM to contribute to vessel remodeling via changes in the ECM composition. The combination of MNLO imaging and biomechanical experiments has great potential for providing critical insights to the pathophysiological mechanisms of plaque rupture.

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Monitoring Diabetic Wound Healing with a Dielectric Probe

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Diabetes is a metabolic disease in which an individual cannot produce enough insulin or utilize the insulin produced by the body. This results in high or low blood glucose levels, which can be fatal if not monitored and controlled.