Neonatal ventricular myocytes (CM) have long been used as an *in vitro* model for hypertrophy studies. In conventional 2D culture, CM lack axial orientation and rhythmic electrical stimulation. Micropatterned cultures can restrict cell attachment to narrow stripes, leading to enhanced axial orientation, particularly in spontaneously contracting CM (Rohr et. al., Circ Res, 1991). In this study, we investigated the effect of continous electrical field stimulation (CES) on micropatterned CM and examined their response to hypertrophic stimulation. Rat CM plated in serum-containing media selectively attached to stripes (100 μm x 10 mm) of fibronectin (FN) that were microcontact-printed onto coverslips. CM cultures were subjected to CES (1 Hz, 5 V/cm) for 48 hrs, with the current applied parallel or perpendicular to FN stripes. To induce a hypertrophic response, micropatterned CM were incubated for 48 hrs in serum-free medium with the α_1 adrenoceptor agonist phenylephrine (PE, together with timolol). We determined that the size, minor/major axis ratio and angles relative to FN stripes of DAPI-stained nuclei can be used as surrogate measures of CM size, elongation and alignment, respectively. Compared to unpaced CM, parallel CES increased nuclear size (1028 ± 121 vs. 798 ± 87 μm^2, $P<0.001$), elongation (minor/major axis: 0.76 ± 0.10 vs. 0.84 ± 0.08, $P<0.001$) and alignment ($P<0.001$, Mardia-Watson-Wheeler circular statistics). Perpendicular CES caused similar but significantly less pronounced changes. PE stimulation increased nuclear size (809 ± 93 vs. 682 ± 99 μm^2, $P<0.05$), but did not increase elongation or alignment with or without CES. In conclusion, CES can be used to enhance the degree of differentiation of micropatterned CM due to continuous electrical activation and/or contractions and does not interfere with their hypertrophic response. Continuously paced micropatterned CM represent an advanced model for the investigation of hypertrophic responses and mechanisms and may be suitable for other applications.

3134-Pos

Epithelial Coating Mechanisms by Semi-Solid Materials: Application to Microbicide Gels

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Many epithelial surfaces have natural coating by polymeric materials, e.g. mucus. Foreign materials may be introduced for coating, e.g. for lubrication or drug delivery: examples are vaginal gels delivering mucosal antigens or topical microbicides. We present here a next generation biophysical vaginal coating model, which supersedes our previous work. The model characterizes the vagina as an elastic tube with a flattened lumen. The walls have porous surfaces through which natural vaginal fluid transudates, contacting and diffusing into a gel coating layer within the lumen. Spreading of the gel layer is driven by gravity and other trans-luminal pressure gradients, and wall elasticity. Gel rheology is characterized by the Carreau constitutive equation, including the presence of a yield stress. The model determines the local dilution of gel as water is transported into it, which is linked to local dilution and time-dependent rheological properties. This association is obtained experimentally. Gel coating flow is computed, accounting for variable properties at each spatial location and time step. A set of current and prototype microbicide gels is being evaluated. Results show the predominance of yield stress at later times during flow; the flow ceases when remaining vaginal wall distension is insufficient to develop shear stresses that exceed the yield stress. Dilution is most important near the vaginal walls and the leading edge of the spreading bolus. It is there that dilution proceeds most quickly, where the local viscosity of the gel drops most, and where spreading accelerates most. For the test gels, there are tradeoffs amongst the dilution-dependent yield stress, limiting low shear viscosity, and rate of shear thinning, in rates of epithelial coating. Practically, these provide flexibility in optimizing gel compositions for target rates of epithelial coating. [Supported by NIH AI48103, CHRP ID07-B-135]

3135-Pos

Mussel-Inspired Self-Healing Hydrogels

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The strength of the coordinate bonds in metal-ligand coordination complexes combined with their capacity to reform after breaking has been proposed as a source of the high toughness and potential self-healing of certain natural materials. Several studies have aimed at testing the mechanical properties of solid-state materials crosslinked with tris-catechol-Fe^{3+} complexes. However, due to the low solubility of Fe^{3+} at high pH, these studies have been performed at low pH favoring mono-catechol-Fe^{3+} complexes and at Fe:catechol ratios >> 1/3, in disagreement with the stoichiometry of tris-catechol-Fe^{3+} complexes. The tough outer cuticle of mussel holdfast threads has recently been shown to be crosslinked by tris-catechol-Fe^{3+} complexes, in agreement with the alkaline pH of seawater (pH 8). Inspired by the likely pH changes in the secretory pathway of mussels we demonstrate that a concentrated solution of a simple polymer modified with catechol and mixed with Fe^{3+} at a Fe:catechol ratio of 1/3 at pH 3 instantly gels via tris-catechol-Fe^{3+} crosslinking upon raising the pH 9. The resulting gels have strengths comparable to covalently cross-linked gels (~ 10^3-10^4 Pa) but with an order of magnitude higher energy dissipation as well as the capacity to self-heal.

3136-Pos

Hydrogel for *in Situ* Encapsulation of Multiple Black Lipid Membranes

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Hydrogels are hydrophilic, porous polymer networks that can absorb water up to thousands of times their own weight. They have many applications, one of which is the encapsulation of free-standing black lipid membranes (BLMs) for novel separation technologies or biosensor applications. We investigated gels for *in situ* encapsulation of multiple black lipid membranes across apertures in a hydrophobic ethylene tetrafluoroethylene (ETFE) support. These gels consisted of networks of poly(ethylene glycol)-dimethacrylate or poly(ethylene glycol)-diacrylate polymerized using either a chemical initiator or a photoinitiator. The hydrogels were studied with regard to their material properties such as chemical resistance, swelling behaviour, water permeability and porosity. We found that lifetimes of membranes in gel precursor solutions were short compared to lifetimes in buffer. However, crosslinking the gel stabilized the membranes and increased BLM longevity substantially over lifetimes in buffer. Optical images of the membranes and incorporation of the transmembrane peptide gramicidin A showed that the lipid membranes retained their integrity after encapsulation with hydrogel.

3137-Pos

Fabricating 3d Ordered Cell Culture Matrix by Microfluidic Device

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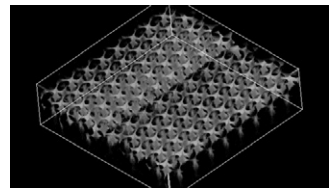
We create a novel 3D matrix with uniform and ordered pores by microfluidic technique. We can vary the pore size and the interconnection between the pores andmeasure the elastic modulus of the matrix. We culture cells inside and observe their morphology by confocal microscopy. Our matrix allows 3D cell cultures in a uniform environment.



3138-Pos

Affinity Baits and the Interior Environment of Hydrogel Particles

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Low molecular weight peptides and proteins can provide biomarkers that are diagnostic for diseases such as cancer. Unfor les can be difficult to isolate and analyze, hampering the identification of suitable biomarkers for many diseases. Thermoresponsive hydrogel particles based on a cross-linked poly(N-isopropylacrylamide), pNIPAm, architecture can be used to harvest biomarkers from biological fluids. The hydrogel particles sequester and concentrate low abundance low molecular weight analytes that can be subsequently analyzed using methods such as mass spectrometry. Introduction of monomers such as acrylic acid and allylamine into the pNIPAm skeleton allows the particles to preferentially attract and concentrate analytes based on charge. Moreover, affinity dyes, such as Cibacron Blue F3G-A, have been added to enhance the harvesting capabilities of particles.[1]

Particles based on pNIPAm shrink and swell in response to changes in environmental conditions, such as temperature, pH and salt concentration. As the pNIPAm particles shrink, their interior environment becomes more hydrophobic, which likely impacts their binding, sequestration and release properties. Here, a phenolphtahlein uptake assay has been used to monitor the interior environment of pNIPAm-based hydrogel particles, and how it changes in response to alterations in the exterior environment. The study focuses on particle responses to changes in the concentration of salts that have been shown to impact particle size, such as guanidinium chloride and ammonium sulfate.