An individual droplet is ideally suited to compartmentalize and confine the DNA put synthesis and screening, and parallel sample processing. Herein, we present note has been the development of microfluidic technologies or 'lab-on-a-chip' posed for biological and chemical analysis for the past two decades. Of particular advance of nonviral gene delivery. The concept of miniaturization has been pro- in size and composition, hindering the establishment of structure-function relation- lular uptake of DNA while protecting it against degradation. This poorly controlled in the structural and chemical properties of DNA nanocomplexes. A commonly the need to improve their delivery efficiencies has provided the impetus to control tial. While nonviral vectors may be safer than viral vectors in intracellular delivery, Nucleic acid-based therapeutics have emerged as a promising class of drugs but 1Duke University, Durham, NC, USA, 2Nankai University, Tianjin, China. deren (ZP2) is cleaved near its N-terminal. The cleavage is believed to alter the ZP system which, henceforth, acts as a barrier to further sperm penetration. We used the atomic force microscope (AFM) to examine both the ZP structure and mechanical properties of the wildtype mouse ZP under physiological condi- tions. For that purpose, patches of isolated mouse ZP were immobilized on poly- lysis coated mica. Imaging revealed two predominant membrane surface mor- phologies consistent with previously reported electron microscopy images of the outer and inner membrane surfaces, respectively, from different species. One is a rough, ruffled surface and the other is a smoother surface with the appearance of a tighter construction. In addition to the surfaces, the structure across the wall thickness was visualized at high resolution revealing a layered, well organized architecture. Elastic modulus estimates from force-indentation data also showed systematic variability mirroring the morphological inhomogeneity. For exam- ple, significant differences in elasticity were measured between the rough re- gions, hypothesized to be outer surfaces, and the smoother regions. Interestingly, these properties also appear to undergo appreciable changes upon fertilization pointing to the structural change effected by the ZP2 cleavage.

**Nano & Microfluidics, Biosensors**

**1000-Pos** Understanding the Stretching of DNA Molecules Confined in Nanofluidic Channels

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Nanofluidic controls of single DNA molecules have provided a new approach of dynamically stretching large DNA molecules. Stretched DNA molecules enables single-molecule schemes aimed at the acquisition of sequence information. Also, nanofluidic DNA molecules provide opportunities to understand mechanistic details that used to be only plausible in theoretical considerations. Here we present the longest DNA molecules stretched in nanochannel ever reported: 20.0 μm out of 21. 8 μm of YOYO-1 intercalated lambda DNA which is 92% of polymer’s full con- tour length in PDMS nanochannels. In addition, we measure these elongations in vari- ous dimensions and reduced ionic strength to facilitate DNA elongation. Finally, we compare our observations with theoretical predictions recently developed.

**1001-Pos** Controlled Synthesis of DNA Nanocomplexes in a Microfluidic Device

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Nucleic acid-based therapeutics have emerged as a promising class of drugs but require a safe and efficient delivery system to realize their full therapeutic poten- tial. While nonviral vectors may be safer than viral vectors in intracellular delivery, the need to improve their delivery efficiencies has provided the impetus to control the structural and chemical properties of DNA nanocomplexes. A commonly adopted approach to synthesize DNA nanocomplexes in nonviral delivery is to complex DNA with a gene carrier via electrostatic self-assembly, facilitating cellu- lar uptake of DNA while protecting it against degradation. This poorly controlled bulk mixing technique, however, generates highly heterogeneous nanocomplexes in size and composition, hindering the establishment of structure-function relation- ship. The poor quality of these nanocomplexes is a significant impediment to the advance of nonviral gene delivery. The concept of miniaturization has been pro- posed with both biological and chemical analysis for the reaction. Of particular note has been the development of microfluidic technologies or "lab-on-a-chip" applications. Micoreactors offer new opportunities due to the enhanced heat/ mas transfer, low power/sample consumption, low production cost, high throughput put synthesis and screening, and parallel sample processing. Herein, we present a controlled synthesis of DNA nanocomplexes in a microfluidic droplet generator. An individual droplet is ideally suited to compartmentalize and confine the DNA and gene carrier solutions. Further, localization of reagents within discrete droplets is an effective way to minimize the dispersion and loss of reacting volumes, which allows precise control of the reaction. This study focuses on the synthesis of DNA nanocomplexes, but the developed technology would also be applicable for other nucleic acid-based payloads, such as aptamer and siRNA.

**1002-Pos** Design of Biosensors Based on the Covalent Assembly of G-Protein Coupled Receptors and Potassium Channels

Lydia N. Caro, Christophe J. Moreau, Jean Revilloud, Julien P. Dupuis, Michel Vivaudou, Institut de Biologie Structurale, Grenoble, France. It is possible to functional coupling between a receptor and an ion channel by covalent linkage so that ligand binding to the receptor modifies channel gating. This was demonstrated with the inward rectifier potassium channel Kir6.2 (the pore subunit of the K_ATP channel) and the muscarinic M2 and dopaminergic D2 G-protein coupled receptors (GPCRs) [Moreau et al., 2008, Nature Nanotech]. To extend this concept of Ion-Channel Coupled Receptor (ICCR), we designed new constructs by engineering fusion between Kir6.2 and 3 GPCRs: the β2 adrenergic, cannabinoid 1 (CB1) and dopaminergic D3 receptors. The receptor C-ter end of the nanocomplexes was engineered as in M2 and D2 ICCRs and joined covalently. The fusions were heterologously expressed in Xenopus oocytes and characterized by the two-electrode voltage clamp technique. Construct names ‘G-Kxx-yy’ indicate the GPCR name (G), the residues clipped off from the GPCR C-ter (xx) and from the Kir6.2 N-ter (yy). A D3-based ICCR, D3-K12-25b, behaved like the D2-based ICCR, showing channel inhibition upon dopamine application. Two β2-based ICCRs were success- fully constructed, β2-K06-24b and β2-K25b. Only when co-expressed with TMD0 (the Kir6.2-anchoring domain of SUR, the regulatory subunit of the K_ATP channel) to augment surface expression, these two ICCRs were reversibly activated by the agonist isoproterenol and inhibited by the antagonist alprenolol. Similarly, a CB1-based ICCR, CB1-K12-25b, was activated by the agonist WIN102, an effect that was enhanced by the presence of TMD0. Thus, the ICCR concept is readily applicable to class A GPCRs. Besides their ob- vious interest in drug screening, the new ICCRs should be valuable tools to investi- gate the intermolecular events involved in the modulation of Kir6.2 gating and the nature of the GPCR conformational changes evoked by their ligands.

**1003-Pos** Broadband Dielectric Spectroscopy of Bovine Serum Albumin and Insulin Solutions in Nanoliter Volumes

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We perform quantitative frequency-dependent dielectric measurements of bovine serum albumin and insulin at varying concentrations using nanoliter measurement volumes. Bovine serum albumin solutions are in buffered water at 1 mg/mL, 10 mg/ mL, and 50 mg/mL, and 40 mg/mL concentrations. Insulin solutions are in HEPES (4- (2-hydroxyethyl) - 1-piperazineethanesulfonic acid) at concentrations of 1 mg/ mL, 5 mg/mL, and 10 mg/mL. A coplanar waveguide is used to extract the fre- quency response from 1 GHz to 40 GHz. An interrogated electrode is used to mea- sure the frequency dependence of the permittivity from 100 kHz to 1 GHz. The measurements are carried out in a 200 micron wide microfluidic channel defined by 50 micron thick SU-8 side-walls and capped with polydimethylsiloxane roof. The conductivity per mL/mg for insulin and bovine serum albumin is approximately linear, and had a slope of –0.08 mg/mL for bovine serum albumin and –0.12 mg/mL for insulin. The permittivity difference was normalized by the concentration and the unique permittivity of each protein was extracted.

**1004-Pos** Cell and Droplet Sorting with Surface Acoustic Waves in Microfluidics

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We describe a novel microfluidic cell sorter which operates in continuous flow at high sorting rates. The device is based on a surface acoustic wave cell-sorting scheme and combines many advantages of fluorescence activated cell sorting (FACS) and droplet sorting in microfluidic channels (FADS). It is fully integrated on a PDMS device, and allows fast electronic control of cell diversion.