water droplet dynamics is important across a wide range of disciplines from climate studies to mass spectrometry and biomolecular imaging. Here we describe the creation of an analytical model of evaporation/condensation that accurately predicts water droplet size and temperature over long time scales. We use this analytical model in concert with molecular dynamics simulations of water nano-droplets to understand the dynamics of these small water droplets at the atomic level. We show that the models and assumptions made in the molecular dynamics simulations are robust and in agreement with experiments and our analytical model. The synergism of these two models highlight and capture the important factors involved in evaporation/condensation of water nano-droplets such as curvature. This ability to predict size and temperature and characterize the droplets at the atomic level will allow for the precise manipulation of water droplets as vehicles for biomolecule payloads in x-ray imaging experiments.

3140-Pos Board B832

Microfluidic Solution Isolated Pumping (μSIP)

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One of the core requirements for the further maturity in microfluidics is to develop a fluid actuation method in bubble-free and power-efficient manner. Although kinds of active and passive fluid control techniques have been described over the past several decades, complex microfluidic systems still require bulky or energy-inefficient actuation components and simpler systems lack the functionality required for a simple field diagnostic test. Here a novel microfluidic pumping strategy is reported which utilizes the high air permeability of silicone materials to actuate fluid flow, named as Microfluidic Sample Isolated Pumping (μSIP). The key elements of μSIP are two channel networks, the fluidic channel and the degas channel, isolated by selective barriers and located in close proximity to each other. The selective barriers allow gas to pass through while being inaccessible for aqueous liquids due to low surface energy of the porous material. An air concentration gradient across the two networks generates an in-situ diffusive flux out of the fluidic channel. It results in fluidic channel pressure reduction which drives the liquid solution into the fluidic channel while the solution being kept isolated from the surrounding degas channels by the selective barrier. To understand the physics behind μSIP, theoretical analysis and experimental characterizations were performed, the experimental data could be well illustrated and predicted by the developed theories and also average flow velocities in the range of 0.7 to 7 mm/s were observed with the current designs. The μSIP provides tunable, reproducible, and bubble-free microfluidic pumping without any auxiliary equipment or device pre-treatment, providing a powerful liquid handling tool for a broad range of applications.

3141-Pos Board B833

Confined Illumination through Apertureless and Nano-Structured Tapered Optical Fibres

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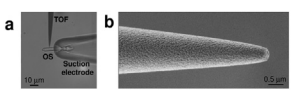
Progress in bionanotechology and in optogenetics requires the production of spots of light with a very precise and controlled intensity profile, polarization and duration. In order to illuminate not more than some tens of rod disks in photoreceptors we have set-up an illumination system consisting of apertureless tapered optical fibres (TOFs) and a laser system. The figure displays isolated intact rod from the Xenopus laevis retina, where the inner segment is drawn inside a suction electrode with a TOF positioned at 90°(left) and SEM image of an apertureless TOF (right). A variety of new TOFs were designed and fabricated generating spots of light with different profiles, ranging from gaussian beam, multispot, Bessel and top hat front wave. Apertureless TOFs or TOFs with very small holes act like an axicon lens. Laser illumination with rapid micro-to milli-second power modulation over 5 orders of magnitude was achieved with a computer controlled assembly of a laser at 491nm, an acousto-optic modulator, a rapid filter wheel equipped with a set of neutral density filters and three ports for optical fibres.



3142-Pos Board B834

Separation of Proteins and Nanoparticles by Charge and Size with a Tunable Semiconductor Membrane

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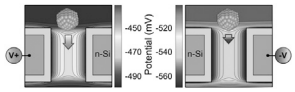
We study the applicability of tunable nanoporous semiconductor membranes made of the heavily doped silicone for separation of nanoparticles and proteins by their size and charge. We demonstrate that this type of membrane can overcome one of the major shortcomings of membrane applications for particle separation: the compromise between membrane selectivity and permeability. The microscopic computational model that we have developed describes the translocation process of filtered objects with the translational-rotational Brownian Dynamics taking into consideration effects from the dielectrophoresis, the electrolyte solution flow, and the self-consistent electrostatic potential distribution within the continuum Poisson-Nernst-Planck approach. Our results indicate that the tunable local electric field arising inside the membrane can effectively control interaction of filtered objects with the nanopore to either block its passage or increase the translocation rate by modulating the electroosmotic flow direction and magnitude. By extracting the membrane permeability from our microscopic simulations, we compute the macroscopic sieving factors and show that the size and charge selectivity of the membrane can be tuned by the applied voltage in the broad range.



3143-Pos Board B835

Single Molecule Ezymology with Electronic Circuits

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Various single-molecule techniques based on optical, electronic, and mechanical mechanisms have proven useful for studying enzymology. Here, we demonstrate an electronic single molecule technique which takes advantage of the sensitivity and bandwidth of a field-effect transistor (FETs) built from a single-walled carbon nanotube (SWNTs). The technique clearly visualizes a wide range of dynamic interactions between enzymes and their substrates, from long-duration variability of catalytic kinetics to short-lived transient states. Measurements with three different enzyme systems (lysozyme, protein kinase A, and DNA polymerase) summarized here suggest the generality and attractiveness of the technique as a new tool to complement other single molecule techniques.

3144-Pos Board B836

Polyelectrolyte Microcapsule Based Assay for Monitoring Biotechnological Processes In Vitro and In Vivo

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The development of non-invasive techniques for monitoring diverse biotechnological processes under production conditions is a challenging and fascinating task. It requires a novel tool that specifically detects final or intermediate products of biotechnological processes, e.g. antibodies or carbohydrates in cell cultures, or moreover any impurities, such as lipopolysaccharides, while eliminating the risk of contamination. The proposed assay should be universally adaptable to many analytes at technologically relevant concentrations and should provide real-time monitoring, high sensitivity, specificity, and robustness under production conditions.

Polyelectrolyte (PE) microcapsules produced by Layer-by-Layer (LbL) assembly can serve as a perfect platform for multiple sensing, because their surface chemistry can be broadly adapted to detect various biomarkers. The measurement principle is based on the induced proximity (clustering) of two different populations of PE-microcapsules carrying detectors for specific recognition sites of an analyte. Due to the relatively large surface area and large number of binding sites, the analyte can be detected over a wide range of concentrations. As a future prospective, the methods developed on the basis of this measurement principle will provide the opportunity to determine the analytes that cannot yet be detected (e.g. intracellular proteins, nucleic acids or metabolites) with high temporal and spatial resolution.