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sufficient for resolving the different DNA bases and paving the way for DNA sequencing in the MHz regime.

2099-Pos Board B829
Electrochemcial Detection of Acetylcholine using Enzyme Functionalized Nanoparticles
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Acetylcholine is a highly important non-electroactive neurotransmitter in the mammalian central nervous system. Its function is linked to memory and sleep, and it regulates, in part, mood and action via its connection to dopamine. A fast, sensitive method to detect the release of acetylcholine at the surface of a single cell is needed to gather data about the kinetics of exocytosis events in these systems.
To this end, carbon fiber electrodes have been modified with electrodeposited gold nanoparticles to increase the effective electrode surface area and provide a high curvature surface for enzyme attachment. Acetylcholinesterase and choline oxidase were then deposited onto the gold surfaces to catalyze acetylcholine to hydrogen peroxide for electrochemical detection. The functionalized electrodes have been characterized to determine the K_M and V_{max} of the enzymes as well as the total enzyme coverage and gold nanoparticle surface area in order to optimize retained enzyme activity. This optimized design has proven capable of detecting release events from an artificial exocytotic system on a sub-second time scale.

2100-Pos Board B830
A Single-Step Digital Nucleic Acid Amplification Platform by Digital Plasma Separation on a Chip
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Quantitative nucleic acid detection is the future for precision molecular medicine. However, multiple sample preparation steps and thermal heat cycles of PCR are necessary for nucleic acid (NA) analysis. We developed a single-step isothermal digital NA amplification microfluidic platform by a technique termed digital plasma separation. We invented an innovative biophysical microcliff design that allows the removal of blood cells based on inertia; it can skim plasma into 224 wells (100nl/well) in one-step (>99% separation efficiency for 6μm particles). By separating the blood cells that obstruct optical detection, the microcliff design enabled quantitative DNA detection via an isothermal DNA amplification technique called Recombinase Polymerase Amplification (RPA) in 30 minutes directly from human blood samples. We were able to perform endpoint quantitative digital RPA with a dynamic range of 10~1000 copies/μl via automatic compartmentalization of the samples. The precise control of fluid flow on chip is accomplished by passive degas-driven flow actuation, which does not require external tubing or pumps, thus making the chip portable. A large amount of sample (~100μl of blood samples) can be processed. We envision this single-step digital blood plasma separation platform will benefit low cost quantitative molecular diagnostics in both developed and developing countries.

2101-Pos Board B831
Single Molecule Detection of Insulin Autoantibodies in Type 1 Diabetes
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Type 1 diabetes (T1D) is characterized as a chronic autoimmune disease caused by a selective inflammatory destruction of the insulin producing beta cells in the pancreatic islets of Langerhans. Closely associated to T1D are insulin autoantibodies (IAAs), representing early markers of the disease. Therefore, their reliable detection is needed i) to predict the onset of T1D, ii) to implement successful regenerative therapies and iii) to prevent loss of the beta cell mass. For this purpose, we developed a novel optical assay for the detection of IAAs using single molecule detection. Our quantitative approach specifically detects IAAs in the low pM range using quantum dots and total internal reflection microscopy (TIRF). This method overcomes the limitations associated with current clinical diagnostic approaches where IAAs are detected using radiolabelled antigens in a time-consuming, hazardous and expensive manner. Thus, we believe that in the future our assay could be used as a point of care measurement for T1D, readily usable in the health care sector combining the prognostic and diagnostic measurements of autoantibodies in T1D.

2102-Pos Board B832
Nanomaterials-Enhanced Electrochemical Biosensor for Detection of Cancer Biomarkers
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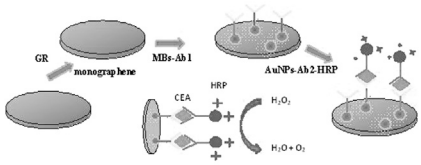
Electrochemical detection strategies employing nanotechnologies which include a variety of new materials and fabrication processes offer new opportunities for highly sensitive detection of cancer biomarkers. This work reports an electrochemical biosensor based on a graphene (GR) platform, combined with magnetic beads (MBs) and enzyme-labeled antibody-gold nanoparticle bioconjugates. MBs coated with capture antibodies (Ab1) were attached to isolated GR sheets by an external magnetic field, to avoid reducing the conductivity of graphene. Sensitivity was also enhanced by modifying the gold nanoparticles (AuNPs) with horseradish peroxidase (HRP) and the detection antibody (Ab2), to form the conjugate Ab2-AuNPs-HRP. Electron transport between the electrode and analyte target was accelerated by the multi-nanomaterial, and the limit of detection (LOD) for carcinoembryonic antigen (CEA) reached 5ng/mL, which meets clinical requirements. The multi-nanomaterial electrode GR/MBs-Ab1/Antigen/Ab2-AuNPs-HRP can be used to detect biomolecules such as CEA. The EC biosensor is sensitive and specific, and has potential in the detection of disease markers.


Figure .Preparation of the multi-nanomaterial EC biosensor and CEA detection procedure.
Keywords: electrochemical, graphene,magnetic beads, gold nanoparticles, horseradish peroxidase.

2103-Pos Board B833
Electrical Pumping of Potassium Ions Against an External Concentration Gradient in a Biological Ion Channel
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We show experimentally and theoretically that significant currents can be obtained with a biological ion channel, the OmpF porin of *Escherichia coli*, using zero-average potentials as driving forces. The channel rectifying properties can be used to pump potassium ions against an external concentration gradient under asymmetric pH conditions. The results are discussed in terms of the ionic selectivity and rectification ratio of the channel. The physical concepts involved may be applied to separation processes with synthetic nanopores and to bioelectrical phenomena.

2104-Pos Board B834
Rapid Detection of Protein Aggregation and Inhibition by Dual Functions of Gold Nanoplasmonic Particles: Catalytic Activator and Optical Reporter
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Neurodegenerative diseases share common molecular mechanisms in disease pathogenesis: protein misfolding and abnormal aggregation. Current detection methods of protein aggregations require time-consuming and labor-intensive steps, which delay the process of drug discovery and understanding the mechanism of protein aggregation. Here, we present a rapid detection method for studying protein aggregation and inhibition under a variety of perturbation conditions by dual functions of gold nanoplasmonic particles (GNPs): catalytic activator and optical reporter. As a proof-of-concept demonstration, we employed the acidic perturbation permitting rapid cooperative assemblies of GNPs and amyloid-β (Aβ) peptides (implicated in Alzheimer's disease) via their surface charge modulation. Because of roles of GNPs as effective nucleation sites for fast-catalyzing protein aggregation and colorimetric optical reporters for tracking protein aggregation, we accomplished the fast aggregation assay in less than 1 min by the naked eyes. Under the given acidic perturbation condition, we characterized the concentration-dependent colorimetric responses for aggregation at physiologically relevant Aβ concentration levels without any instrumentation. We also demonstrated the GNP/acidic condition-based rapid inhibition assay of Aβ aggregation by using well-known binding reagents such as antibody and serum albumin. Consistent results were also obtained from the tests with superoxide dismutase protein implicated in Lou Gehrig's disease. The proposed methodology can be a powerful

alternative method for screening drugs for neurodegenerative disease as well as studying molecular biophysics of protein aggregations, and further extended to explore other protein conformational diseases.

2105-Pos Board B835

Novel Biosensor for Point of Care Medical Diagnostics

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Point Of Care (POC) diagnostic devices enable clinicians to provide rapid diagnoses at the time and location of care. Such POC devices are particularly relevant in world regions where access to laboratory facilities is limited or unavailable. In these applications, portability, economy, and versatility are paramount. Much of the recent research in biosensors, however, has been focused on high selectivity and high sensitivity. This focus has led to devices which require lengthy amplification schemes and/or require specialized and costly detection equipment. In addition, many of the most sensitive or selective biosensing paradigms are applicable to only a limited range of analytes. In the realm of POC diagnostics, there remains a particular need for rapid, inexpensive sensors which are portable and generalizable to a wide range of analytes. In this work, we have designed a novel biosensor which meets these needs. This sensor consists of an array of micro-posts embedded within a microfluidic channel. The post array is saturated with an aqueous solution containing well-dispersed 1-um superparamagnetic microbeads. Both the beads and the posts are chemically functionalized such that the presence of a targeted analyte will cause irreversible binding of beads to posts, which results in a detectable modulation in optical transmission. In an initial proof-of-principle, we have biotinylated both the beads and posts such that they bind in the presence of streptavidin; however, with appropriate functionalization the sensor could be designed to detect any of a wide variety of analytes with varying degrees of specificity. Our current fabrication methods would facilitate multi-channel detection from a single biological sample. While this biosensing mechanism is not as sensitive as many in development today, its generalizability and ease of use would make it ideal for point-of-care medical diagnostics in areas without access to diagnostic laboratories.

2106-Pos Board B836

Transparent Multi-Suction Electrode Arrays for *in vitro* Neural Network Investigations

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Large-scale multisite electrophysiology recordings with high temporal resolution are essential to discover neural circuitry and elucidate their structure-function relationship. We contribute to this effort by combining multielectrode arrays (MEAs) with through pore arrays in quartz substrates to create multi-suction electrode arrays. The MEA allows for multisite extracellular recordings from neural tissue while the through pore array permits suction to be applied to the tissue to form more intimate contact with the electrodes. We successfully recorded from mouse hippocampi, mouse retina, and leech segmental ganglia. Hippocampus and retina tissue show at least a 50% increase in S/N and twofold increase in detectable spikes following suction. (Interestingly, spiking activity and S/N of spikes in leech ganglia mostly do not increase after applied suction, suggesting sources deeper in the tissue.) Finally, we demonstrate optical imaging through the transparent substrate to visualize the neurons at the electrode interface simultaneously with electrophysiology recordings. This technology will facilitate the combination of optical-based measurements such as voltage-sensitive dye imaging with multisite electrophysiological recordings with high temporal resolution of neuronal networks in a wide range of vertebrate and invertebrate preparations, at the single spike level.

2107-Pos Board B837

Polydiacetylene (PDA) Vesicle Based Colorimetric Biosensor for Detection of Genetically Modified (GM) Crops

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Food crisis is one of the most important issues around the world. With a population explosion, Harvesting crops in a classical manner no longer keep up with population explosion. In addition, agricultural pesticide and insect pest give rise to environmental problems. Recent advances in biotechnology ameliorates both issues by inserting productivity amplifying gene and pesticide neutralizing protein encoded gene, maximizing crop productivity and producing pesticide resistant crop, so-called genetically modified (GM) crops. Due to the bioethical issues and potential risk to human, people are concerned about the GM crops, thus many countries make regulations for the GM crops. In order to regulate GM crops, we need fast, accurate and simple methods to the GM crops. In this study we have devised a biosensor to detect phosphinothricin acetyltransferase (PAT) protein that makes GM crops resistant to herbicides. In order to detect PAT protein, anti-PAT antibody was conjugated to polydiacetylene (PDA) vesicles. PDA vesicles have unique colorimetric characteristics, changing their color from blue to red upon external stimuli. Anti-PAT antibody conjugated PDA vesicles are subsequently encapsulated within hydrogel matrix to maximize the intensity of color change, resulting in the sensitivity enhancement of the sensor. Our biosensor could detect as low as the 20nM of PAT protein. Furthermore we developed a microfluidic device to automate the production of uniform sized immunohydrogel beads. Our simple biosensor can be identified by the naked eyes without the aid of special instrument or expertise, widening the potential applications in the area of point-of-care testing (POCT).

2108-Pos Board B838

Paper-Based Integrated Diagnostic Device for Nucleic Acid Detection of HIV from Blood

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Paper materials with good biocompatibility, porous structures, hydrophilic property, capillary effect, low non-specific binding, and multi-modification have been widely applied in diagnostic devices for environmental monitoring, food safety, and healthcare. However, utilizing these properties on one paper chip for quantitative measurement of nucleic acid amplification from blood is a big challenge for point-of-care (POC) device. Here we report an integrative paper-based molecular diagnostic device (IPMD) with the capability of fast plasma separation and sensitive nucleic acid (NA) detection of HIV from blood. The IPMD is composed of a highly efficient plasma generation membrane over a rapid flow nitrocellulose layer for plasma separation, HIV NA collection, amplification, and fluorescence read-out. 100 μL of whole blood sample is separated on-chip within 5 min. The hydrophilic, porous, capillary properties of nitrocellulose are beneficial to pre-store all the chemical components of nucleic acid amplification by a lyophilization process. HIV NA with a limit-of-detection of 10 copies is achieved by analyzing the fluorescence intensity of the nitrocellulose layer after NA amplification for 20 min. These results suggest that our IMPD platform can promote the development of POC devices for global healthcare and personalized medicine.

2109-Pos Board B839

Rapid Detection of Methicillin-Resistant Staphylococcus Aureus using Bubble-Free Microfluidic PCR

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Methicillin-resistant Staphylococcus aureus (MRSA) is the most common hospital-acquired infection and resistant to certain drugs; therefore, reliable PCR detection of MRSA is critical for early prevention of disease spread and the effective treatment of infections. The major problems of microfluidic PCR are water evaporation, loss of reagents, and inconsistent optical path-length due to random bubble generations during the thermal cycling. We report a bubble-free microfluidic PCR for the detection of MRSA. In order to avoid the bubble generation, we utilized polyethylene-based microfluidic devices since it has low gas permeability. The proposed polyethylene microfluidic PCR also offers a uniform heat distribution without the amplification inhibition by a temperature drop in the aqueous nucleic acid sample. The polyethylene layer was spin-coated over PDMS channel for effective hybrid integration of two different functions of polymeric materials (i.e. degasing pump for PDMS and polyethylene for uniform PCR and optical path-length). Consequently overall sample loss such as PCR reagent and nucleic acid was almost eliminated by bubble-free condition. The detection limit of mecA which is methicillin-resistance gene was found to be 6.4 x 102 copies of MRSA genomic DNA by the end-point fluorescence analysis for approximately 30 min reaction. The bubble-free multiplexed microfluidic MRSA PCR array will benefit for rapid detection and drug resistance determination effectively.

2110-Pos Board B840

Simple Detection of Amyloid-Beta Peptide for a Diagnosis of Alzheimer's Disease using Photo-Sensitive Fet with Optical Filtering Layer

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Alzheimer's disease (AD) is a degenerative brain disease, and there are some limitations for an early diagnosis because the main cause and a remedy for