nanocluster formation, as these are essentially non-fluorescent. Our detection technique is simple, inexpensive, and compatible with commercial DNA synthesizers. It is also the first demonstration that a turn-on probe can be made based on fluorescent noble metal nanoclusters.
Our initial investigation demonstrated NCB detection of an influenza target with a signal-to-background (S/B) ratio five times better than that of a conventional molecular beacon. Here, we expand upon this work to demonstrate a method of using NCBs to differentiate single-nucleotide variations. Our method discriminates single-nucleotide variants by colorimetric change of the NCB probes rather than fluorescence intensity change. This added dimensionality enables the increase in fluorescence intensity (on/off switching) to quantify the amount of target, whereas the fluorescence color identifies single-nucleotide variants. Samples with single-nucleotide variations can be unambiguously identified on a common gel imager with naked eyes, making this method a reliable and low-cost assay with simple readout format.
Ref: H.-C. Yeh et al., "A DNA-silver nanocluster probe that fluoresces upon hybridization," Nano Letters 10 (8): 3106-3110, 2010.

2630-Pos Board B616
Real-Time Label Free Analysis of Native Bacterial Cells Binding to Carbohydrate Microarray
Yiyan Fei, Carlito Lebrilla, Jay Solnick, Thomas Boren, Xiangdong Zhu.
We present a novel experimental system based on glycoconjugates microarray and oblique-incidence reflectivity difference (OI-RD) microscopy to analyze binding of the onco-pathogen *Helicobacter pylori* to surface immobilized carbohydrates. The results confirm the recognized high-affinity binding of *H. pylori* BabA to the fucosylated Le^b antigen, and suggest the presence of additional Le^b binding adhesins not previously detected. OI-RD microscopy is a recently developed method for analyses of label-free biomolecules binding to immobilized targets by measuring small changes in phase and amplitude of a reflected optical wave from a solid surface due to the reaction of a solution-phase probe with the target. Besides applications of OI-RD in DNA hybridization, antigen-antibody interactions and small molecule libraries screening, we apply OI-RD microscopy to the binding analyses of whole bacterial cells to their host receptors presented on surfaces. Glycoconjugates microarrays consisting of Le^a-HSA, Le^b-HSA, Le^x-HSA, and Le^y-HSA were probed with *H. pylori*, *H. pylori* BabA deletion mutant and recombinant BabA protein. *H. pylori* demonstrated specific binding to Le^b antigen, but did not bind to the closely related Le^a, Le^x or Le^y antigens. The specificity in binding to the Le^b antigen and not to Le^a, Le^x or Le^y antigens was faithfully reproduced by recombinant BabA protein. Besides, *H. pylori* BabA deletion mutant does not express BabA and does not bind to Le^b-HSA in solution, also demonstrated specific albeit reduced binding to Le^b antigen. These results suggest that some *H. pylori* strains exhibit a complementary Le^b-binding activity (independent of BabA) that has not been previously detected. The OI-RD technology with real-time analyses of whole cell bacterial binding to multivalently presented receptors in solid phase combined with magnified sensitivity for weaker adherence properties, offers new possibilities for identification of discrete attachment mechanisms essential for the infectious.

2631-Pos Board B617
Probing the Strength of a Bio-Nano Hub by Single-Molecule Force Spectroscopy
Minkyu Kim, Mahir Rabbi, Piotr E. Marszalek.
Natural and synthetic polypeptides have been proposed to be utilized as nano building blocks for biomolecular materials due to their unique mechanical properties, such as spring or shock absorber behaviors. Chemical linkages are commonly employed due to their strong covalent bonds to assemble these building blocks. However, biomaterials composed of these building blocks randomly associated by chemical linkages, typically lose the original mechanical properties of their molecular framework. Here, we have created two dimensional (2D) bio-nano structures by using tetrameric streptavidin as a biological cross-linker, and directly measured the strength of streptavidin tetramers with the AFM. The strength of this biological linkage is capable of maintaining naturally cross-assembled 2D nanostructures, with the measured lowest unbinding force of ~ 400 pN at loading rates of ~10 nN/s. We reveal mechanically one of the strongest non-covalent biological linkages in nature, making streptavidin a strong potential structural nano-hub for hierarchical biomolecular-based materials. (This work is supported by NIH).

2632-Pos Board B618
Heterogeneous Immunosensors that Do not Require Protein Immobilization
Ewa Heyduk, Agnieszka Lass, Ling Tian, **Tomasz Heyduk**.
We have recently described a homogenous immunosensor design that utilizes target-induced annealing of the oligonucleotides attached to the antibodies via nanometer-size flexible linkers to generate fluorescence signal allowing rapid detection of the target. Here we describe an alternative variant of this sensor design in which the presence of the target induces an association of antibody-target complex with oligonucleotide-functionalized solid surface. This allows designing solid-surface based sensors for detecting proteins that avoid technical difficulties involved in immobilizing antibodies or antigens. We used human cardiac troponin, CEA and pathogenic bacteria (E. coli O157:H7) as example targets to test and demonstrate the applicability of our design. Microplate wells or glass slides were functionalized with the oligonucleotide containing complementary sequences to the fluorochrome-labeled oligonucleotides attached to target-specific antibodies. Target-concentration dependent signals were observed in the presence of antibodies and the target whereas only background fluorescence was observed with the antibodies in the absence of the target. Since all interactions with the glass surface in our design are mediated through oligonucleotide-oligonucleotide interactions, the sensors can be quickly regenerated by a simple low salt wash. Stability of immobilized oligonucleotides allows reusing the sensors multiple times without loss of functionality. Since multiplexing could be accommodated in this sensor design, we believe these sensors will find applications for parallel detection of multiple targets. A single sensor could be used for detecting different targets by matching the sequences of the oligonucleotides used for labeling the antibodies with the sequence of oligonucleotides immobilized on sensor surface.

2633-Pos Board B619
Determination of Contamination of Beverages using Dielectric Spectroscopy
Christopher E. Bassey, Sarah A. Mintah.
Knowledge of the dielectric properties of beverages and juices provides information on their purity, quality and composition. Dielectric properties such as relative permittivity, dielectric loss factor, and electrical conductivity were measured as a function of frequency using an open-ended dielectric probe in conjunction with an automatic network analyzer (ANA) between 0.1 and 3 GHz frequency range. Dielectric properties of pure drinks such as Gatorade, water, wine, beer, and drinks contaminated with various volumes of ethylene glycol were measured at a temperature of 20.0 degrees Celsius. Results showed a decrease in dielectric constant with frequency for all samples. There was- a linear increase in dielectric constant with per cent volume contaminant. Results also showed an increase in the dielectric relaxation time of the contaminated drinks with the level of contamination, which is attributed to the increased charge content in the contaminated drinks. The minimum detectable per cent contamination was about 1 %. This technique holds a strong potential for use in routine quality control measurements in pharmaceutical industries and wineries.

2634-Pos Board B620
Subpicosecond Photonic Switching Based on Bacteriorhodopsin
Pal Ormos, László Fábián, Zsuzsanna Heiner, Mark Mero, Miklós Kiss, Elmar K. Wolff, Károly Osvay, András Dér.
The continuous growth of internet traffic represents a serious demand for significant improvement both in capacity and speed of data trafficking. All-optical data processing is generally considered to be the most promising approach to achieve these goals. The state-of-the-art photonic integration technology is ready to provide the passive elements of the optical integrated circuits. The bottle-neck is a proper nonlinear optical material in waveguide-based integrated optical circuits that provide the light-controlled active functions. Several inorganic and organic materials have been suggested for this special application, however, none of them is considered to be the optimal solution.
Here we present a subpicosecond photonic switch where the active role is performed by the chromoprotein bacteriorhodopsin. The changes in the refractive index that accompany the steps of the photocycle of bacteriorhodopsin are used for all optical switching in appropriate integrated optical devices. We use grating coupled planar waveguides and the coupling is modulated by the light induced refractive index changes of bacteriorhodopsin. The switching is demonstrated in ultrafast pump-probe experiments. Different transitions of the photocycle are explored for switching applications. We show that by using the bR to I transition subpicosecond switching can be readily achieved. The approach may serve as a basis for the realization of protein-based integrated optical devices, eventually leading to a conceptual revolution in telecommunications technologies.

2635-Pos Board B621
Characterization of Quantitative FRET Sensors for Fluorescence Molecular Tomography
Qing Liu, Xin Xie, Yi Zhang, Yanyan Xu, Yue Zhang, Xin Liu, Jing Bai, Xiaodong Liu.
Fluorescence molecular tomography (FMT) emerges as a promising approach to acquire dynamic information of key molecules *in vivo*. We propose to utilize $BSCaM_{IQ}$, FRET (Fluorescence Resonance Energy Transfer) sensors of calmodulin (CaM), to achieve more specific and robust measurement for FMT targeting CaM. First, whole-cell patch clamp is applied to cells co-expressed with L-type voltage gated Ca^{2+} channels and $BSCaM_{IQ}$ sensors. This way, we validate and