Sesssion 10

Biochemical, Molecular, and Biomedical Engineering

Session Moderator: Daniel Ratner, Bioengineering
Mary Gates Hall 389
1:00 PM to 2:30 PM

Dissolvable Bridges for Manipulating Fluid Volumes in Paper Networks
Jared Scott (Jared) Houghtaling, Junior, Bioengineering
Mary Gates Scholar
Mentor: Elain Fu, Bioengineering

Paper-based diagnostic assays have become popular for their use in the detection of both pregnancy and infectious disease. The majority of lateral flow tests are run using a paper-like membrane called nitrocellulose on which liquid can flow using capillary action until it reaches the spot or line containing capture reagents. They provide an inexpensive, user-friendly alternative to expensive lab-based analysis. However, commercial paper-based assays typically only run single step processes that can lead to inaccurate results. Our goal is to create more sophisticated assays that can perform multi-step processes for higher performance using paper networks. In order to achieve this goal, we need to create paper fluidic valves to regulate fluid flow in these devices. For a simple shut-off valve, we came up with the idea of placing a sugar cube in a gap between two strips of paper so it would act as a temporary bridge and allow a certain amount of fluid to flow through until the sugar dissolved. This would enable specific volumes of fluid to flow through different channels – something normally regulated by trained personnel operating pipettes in the lab – with an untrained user merely having to add excess fluid to a single well. Dissolvable sugar bridges can serve as a method for manipulating fluid/reagent volumes within paper-based devices. We’ve been able to demonstrate and characterize their operation, including tunability using parameters such as geometry and composition. We’ve also demonstrated the utility of dissolvable bridges in the important context of automated delivery of different volumes of the same reagent (e.g. water) from a common source to multiple locations in an assay for simple device loading and activation. Sugar bridges have the potential to help bring advanced testing using paper networks to limited-resource settings.

Poster Session 2

Commons East, Easel 81
2:00 PM to 3:30 PM

Development of a Prototype Malarial Diagnostic Device
Tinny Liang, Senior, Bioengineering
Mary Gates Scholar
Mentor: Elain Fu, Bioengineering

Millions of people in developing countries die from infectious diseases (e.g. malaria and dengue), yet many of these deaths can be prevented if given the tools for accurate diagnosis. However, current diagnostic capabilities with the required clinical sensitivity, a measure of the number of people with the disease who are correctly diagnosed, are confined to laboratory settings due to cost, electrical, and personnel requirements. Thus there is a medical need for diagnostic tools with the required level of clinical sensitivity for use in low resource settings. The current standard test performed in low resource settings is a lateral flow test, like the common pregnancy test, which incorporates gold labeled molecules that allow for visual detection of antigen, e.g. disease specific protein, levels in a sample. In previous work, I helped design a prototype paper-based malarial diagnostic test that utilized a gold enhancement solution via a metal catalytic reaction to amplify the gold labeled molecules with a four-fold increase in sensitivity. The goal of my project is to increase sensitivity further by characterizing the effect of gold label particle size on the performance of gold and silver enhancement solutions. The gold label acts as the catalyst for the metal catalytic reactions. Smaller gold particles have the potential to bind at higher densities in the detection region, which could increase the catalytic surface area for the metal catalytic reaction and potentially lead to greater improvement in sensitivity. For my project I will redesign the current prototype malarial diagnostic test to incorporate the most promising signal amplification reagents, and the sensitivity of the device will be characterized.
Development of Diamond Based Magnetometer for Nanotag Sensing at Room Temperature
Zhiting Zhu, Junior Electrical Engineering, Computer Engineering
Mentor: Kai-Mei Fu, Physics/ECE

The ability to detect magnetic nanoparticle tags could be an important technique in a wide variety of biological applications such as particle tracking and immunoassay labeling. We aim to detect magnetic fields at the nanometer scale using the optical detection of the electron spin resonances of Nitrogen Vacancy (NV) centers in diamond. This system combines the possibility of high spatial resolution with magnetic sensitivity. I am developing a diamond based magnetometer designed for biomagnetic nanotag sensing at room temperature. The magnetometer is a diamond substrate with a dense layer of NV centers at the surface. Magnetic nanoparticles are placed on the surface and detected by utilizing wide-field photoluminescence imaging. The intensity of the NV photoluminescence is highly sensitive to magnetic field; therefore we can obtain information about the local magnetic field magnitude and direction and thus the position of the nanotags. I am working on building data acquisition and instrument control software for the magneto-optical microscope. It involves instrument control of a Radio Frequency (RF) signal generator, automated data acquisition using an EMCCD camera, integration of RF unit with data acquisition and real time image processing.

POSTER SESSION 3
Balcony, Easel 99
4:00 PM to 5:30 PM

Sources of Sexual and Reproductive Health Information among Luo Youth
Sarah L. (Sarah) Mc Dowell, Senior, Nursing
Mentor: Elaine Adams Thompson, Psychosocial & Community Health
Mentor: Amelia Knopf, Nursing
Mentor: Lisa Mills, Centers for Disease Control and Prevention

The purpose of the study is to contribute to the development of HIV prevention efforts by determining primary sources of reproductive health information for Luo youth of Western Kenya. In 2006, there were an estimated 55,000 new HIV infections in Kenya; the majority affected youth aged 15-24. HIV prevalence is highest, 20.2%, among the Luo ethnic group. The high infection rate among youth generally, and among the Luo in particular, stresses the need for HIV prevention tailored for Luo youth, which can be informed by existing survey data. The Asembo Baseline Cross Sectional Survey (Asembo BCS) was conducted by the Kenya Medical Research Institute & Centers for Disease Control and Prevention’s HIV Research Branch in 2003-2004 in the rural, predominately Luo community of Asembo. Interviewers collected data on health information-seeking behaviors, sexuality, gender norms, and HIV prevalence and risk factors from 1822 randomly selected Asembo residents. We conducted a secondary analysis using the Asembo BCS database, focusing on Luo youth respondents ages 13-24 (n=1,283). Factors examined included identification of the most important and preferred source of sexual health information, types of sexual health issues typically discussed with parents and friends, comfort level speaking with parents about sexuality, sources of HIV/AIDS information, and whether the youth had recently received HIV/AIDS information. Using descriptive statistics we characterized the distribution, dispersion, and central tendency of these factors. Preliminary results suggest that important and preferred sources of reproductive health information include schools, media and friends. Additional analyses are being conducted to describe parent-youth communication and recent exposure to HIV/AIDS information. Findings regarding where and from whom Luo youth receive information about sexual and reproductive health will be used to inform the design of targeted HIV prevention for Luo youth.