Novel Technology for Detecting Nucleic Acids
(Better tools through Better Chemistry of Materials)

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**Objectives**

**DNA detection**

Understand DNA/DNA binding, kinetics  *Make DNA detection robust, sensitive* Jonas Boateng, PhD (2012)

**Bioinformatics**

How can we improve database searches through better understanding of protein/DNA/RNA sequences (*on going project, David Cavanaugh*)
**Nucleic Acid Testing**

**Principles** Source of infection (nucleic acid, genome) always present and is a necessary condition for pathologies due to infection

**Uniqueness** Unique sequences can be identified once the genome has been sequenced/known for the pathogens (viruses, bacteria, fungi)

**Detection Approach** Design complementary sequence to look for sequences *known* to be present in pathogens (bioinformatics, computer data mining)
Detecting Nucleic Acids
Nucleic Acid Testing

Difficult to detect, low concentrations, amplification needed (of targets or signal)

Target Amplification

Polymerase Chain Reaction *molecular xeroxing, making multiple identical copies of nucleic acids not robust for clinical applications, lot of work being done*

Signal Amplification

Gold nanoparticles, Surface Enhancement of fluorescence, vibrational spectra *good, early promise, nothing clinical yet*

So, we came up with an idea ...
Detecting Nucleic Acids

Target sequence not bound - detection negative (hairpin refolds)

Target sequence bound - detection positive
Effect on Surface Chemical Spacing on DNA/DNA binding Biosensors and Bioelectronics, 2011, vol 26, pp 2566-2573
Innovative Surface Coating for Biochips and Picoforce AFM
Engineered Surfaces

Detecting Nucleic Acids

Dendron

Dendron modified slide with aldehyde functionalized apexes
Detecting Nucleic Acids
4nm – NSB9 Dendron

7nm – NSB27 Dendron
Chemical Spacing Matters

Detecting Nucleic Acids

MatSci Faculty Meeting (12-05-2012)
Detecting Multiple Species

Detecting Nucleic Acids

MatSci Faculty Meeting (12-05-2012)
Engineered Surfaces
Spacing of functional groups allows for control of steric hindrance, allows for the lowering of detection limits

Structure and Function
Designing DNA probes that have specific sequences and structure allows for detecting multiple targets in complex solutions, including for medical diagnostics
Jonas Boateng (MWS Operon), Joel Peek (Microarrays Inc./HudsonAlpha), Robert Zahorchak (HudsonAlpha) (Jeffrey Dowell, Marc Pusey, Joseph Ng)