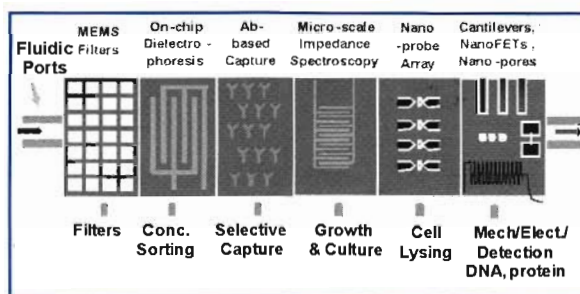


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**This high quality abstract was  
 presented at the BMES 2007 Annual  
 Fall meeting**

**The Problem.** Early detection of pathogens has long been a critical issue for food safety and public health. In the past decades, much research has been done for rapid detection of microorganisms that cause outbreaks of food-borne illness. However, most of these methods are time consuming and labor intensive requiring a high level of expertise. Our research group has been working on developing simple, automated and portable microfluidic devices for rapid detection of microorganisms based on label-free electrical measurements and impedance spectroscopy. Typically, nucleic acid-based methods are still considered the gold-standard for detection and identification of microorganisms due to their high

specificity and selectivity as compared to antibody-based assays. The test of choice for detection of target DNA molecules is Polymerase Chain Reaction (PCR). Conventional PCR requires the introduction of fluorescent labels in the solution mix, which produce light when incorporated into the amplified DNA product.



**Figure 1: Schematic of a modular lab on a chip for detection of microorganisms.**

New methods for the label free detection of the amplified nucleic acid product would reduce the cost and make it easier to miniaturize the measurement apparatus. Hence, label-free detection of DNA molecules is a quest of utmost importance.

**Detector on a Chip.** A schematic of an integrated lab on a chip device is shown in Figure 1, where the appropriate module could be integrated depending on specific applications and the analysis to be performed. The final step of any such analysis is the identification of the target microorganism. The direct electrical detection of DNA in solution is potentially a very attractive option, especially if differences in length and concentrations can be detected directly without any labels or attaching the molecules to a surface. It has been known that the presence of dsDNA molecules suspended in solution can be detected directly without any labels by measuring the impedance of the solution that the molecules are

suspended in, provided that the concentration of the molecules is above a critical threshold. We used microscale devices with integrated metal electrodes to perform electrical impedance measurements

*(continued on page 15)*

## Tenured and Tenure-Track Positions in Bioengineering



The Volgenau School of Information Technology and Engineering at George Mason University is seeking faculty to assist in the building of a new program in bioengineering. Each successful applicant will receive a tenure track appointment at the Assistant, Associate or Full Professor level in one of the existing six Volgenau School departments. Additional information on these departments is available at [http://volgenau.gmu.edu/about\\_ite/departments](http://volgenau.gmu.edu/about_ite/departments).

Successful candidates are expected to shape bioengineering at George Mason University by maintaining an active research program and teaching both at the undergraduate and graduate levels. Applicants for Assistant Professor must have earned a doctorate, or be very near to completing such a degree, in bioengineering, biomedical engineering, or a closely related field. Applicants for a more senior, possibly tenured, position must have demonstrated substantial leadership in bioengineering.

Candidates should show evidence of strong research and teaching ability in one or more emerging areas of Bioengineering. Neuroengineering, rehabilitation engineering, and proteomics are of special interest.

Questions about the position should be directed to Dr. Peter Katona, Professor and Chair, Bioengineering Search Committee ([pkatona@gmu.edu](mailto:pkatona@gmu.edu)).

Interested individuals should submit a CV and letter of intent (including statements of research and teaching interests and accomplishments, as well as their departmental preference), and names and contacts of three references for position F9165Z at <http://jobs.gmu.edu>. The review of applications will begin immediately and continue until the positions are filled.

George Mason University is a growing, innovative, entrepreneurial institution with national distinction in several academic fields. Enrollment is 30,000, with students studying in over 100 degree programs on four campuses in the greater Washington, DC area. Potential interactions with government agencies, industry, medical institutions, and other universities abound. GMU is an equal opportunity employer that encourages diversity.

## DNA Molecules

*continued from page 14*

of solutions with DNA molecules and found that the threshold of detection is about  $1 \times 10^8$  molecules/ $\mu\text{L}$  in de-ionized water. This corresponds to approximately nM concentration for a 400 bp (base pair) dsDNA (double stranded DNA) molecule. The impedance magnitude was found to decrease as the concentration of the 400 bp dsDNA was increased. Similarly, at fixed concentrations, the impedance magnitude was also found to decrease as the length of the dsDNA molecule was increased. We fitted the measured impedance data to an equivalent circuit model and our results show that the extracted dielectric capacitance and conductance of the solution increase with molecule length and concentration owing to a corresponding increase in number of DNA dipoles and counter-ions in solution. We also found that the threshold of electrical detection was about  $1 \times 10^{16}$  molecules/ $\mu\text{L}$

in PCR solution (i.e. in the presence of all components necessary to perform PCR).

**The Goal.** It should be possible to directly detect the amplified product of PCR reactions using electrical means as long as the amplified molecules can remain concentrated in a very small volume. So a solution could be used with about 1000 bacterial cells flown through a channel with the bacteria confined in a 0.1 nL volume. If the bacteria were lysed and the target DNA segments were amplified in 30 cycles (amplified by  $1 \times 10^9$  times), and if the amplified product was confined to the same volume, then the amplified product would change the electrical properties of the solution. We envision a cartridge with an electrical and fluidic interface to a hand held reader, where the entire assay can be performed in a miniaturized format to provide information of identification of target pathogenic microorganism based on detection of target nucleic acids. ♦

## Canver's Corner

*Matt Canver*

*Do you have a question that is burning inside you, but you can't get a straight answer? Do you want to know about biomedical engineering, school, career, or life? Matt Canver at the University of Pennsylvania will answer all your questions. Just email them to him at [canver@seas.upenn.edu](mailto:canver@seas.upenn.edu)*

**Question: What** can I do with a degree in Biomedical Engineering?

The race to develop the latest life-saving technology has often involved the intersection of engineering with the biomedical sciences. Influential medical advances such as the defibrillator and the heart-lung machine exemplify the possible success of such an interaction. As the population continues to age and health issues flood the media, biomedical engineering's place in society continues to grow. Engineers number 1.5 million in the work force, with 20% of those being biomedical engineers. Strikingly, the U.S. Bureau of Labor Statistics has predicted a steep growth in biomedical engineer employment through 2016. In addition

to this wide marketability, a biomedical engineering degree has the advantage of versatility. Here are some common paths taken by students after receiving a Bachelor's degree in biomedical engineering:

### **Graduate School**

Many graduates elect to pursue further study to obtain either a Master's or Doctoral degree in biomedical engineering. These advanced graduate degrees open many additional job possibilities, especially in the biotechnology industry and academia. Medical school is also a popular choice for biomedical engineering graduates. The strong technical background provides a sound basis for tackling clinical problems. The option for a combined MD/PhD path, totally about 8 to 9 years, is becoming increasingly common. Business school is another frequent path for biomedical engineers. A Master's in Business Administration (MBA) can open many doors, particularly in industry jobs or in developing your own biotechnology company.

### **Workforce**

It is common for graduates to enter the workforce after graduation. This is no  
*(continued on page 16)*



## Biomedical Engineering Faculty Positions Louisiana Tech University

The Biomedical Engineering Program seeks applicants for tenure-track positions at all academic ranks, including candidates for the **Rhodes Endowed Chair**. Positions require an earned doctorate in an appropriate engineering or science field, excellent oral and written communication skills, and an ability to work in a team-oriented environment. Preference will be given to applicants with research interests that have potential for collaboration in the following strategic areas: Bio-Micro/Nano Systems, Neural Engineering, and Cell/Tissue Engineering.

**The Louisiana Tech University Biomedical Engineering Program** offers B.S., M.S., and Ph.D. degrees in Biomedical Engineering. Resources include a new Biomedical Engineering Building that is physically connected to Tech's nationally recognized Institute for Micromanufacturing with access to state-of-the-art Micro/Nanofabrication facilities, and high-end computational resources (Lambda Rail network). For more information, visit our web sites at [www.latech.edu/coes/biomedical-engineering](http://www.latech.edu/coes/biomedical-engineering) and <http://www.latech.edu/ifm/>.

**Faculty Positions:** Junior applicants must build and sustain an externally-funded research program, supervise masters and doctoral students, and teach undergraduate and graduate courses. They must have a commitment to professional service and a desire to participate in college responsibilities. Senior applicants must have built and sustained an externally-funded research program, have a history of masters and doctoral student supervision, a distinguished publication record, a history of professional service and a commitment to undergraduate and graduate student education.

**The Rhodes Endowed Chair** will provide leadership in multidisciplinary research efforts and must have a distinguished scholarship and research record, a history of research funding, and strong administrative skills. The Rhodes Chair must be a US citizen or permanent resident.

Applications will be reviewed until suitable applicants/candidates are identified. The projected start date is September 1, 2009 or sooner. Louisiana Tech University is an EEO/AA employer. Women and minorities are encouraged to apply.

**Send electronic applications (including CV, three references, a statement of teaching philosophy and a statement of current/future research interests and goals) to:**

Dr. Eric J. Guilbeau  
Chair, Biomedical Engineering Search Team  
Louisiana Tech University  
P.O. Box 10157, Ruston, LA 71272  
Tel: (318) 257-5208, Fax: (318) 257-4000  
Email: [biensearch@latech.edu](mailto:biensearch@latech.edu)