AlGaN high electron mobility transistor based DNA sensor

Resham Thapa[1], Fei Tong[1], Moonil Kim[3], Michael Bozack[1], Ahjeong Son[2], and Minseo Park[1].*

[1]Department of Physics, Auburn University, Auburn, AL, 36849 USA

[2]Department of Civil Engineering, Auburn University, Auburn, AL 36849 USA

[3]Department of Pathobiology, Tuskegee University, Tuskegee, AL, 36088 USA

*Corresponding Author (park@physics.auburn.edu)

It is very important to rapidly detect and identify bacterial pathogens contained in food. Numerous studies have been performed to develop a biosensor to detect the biopathogens contained in food. Due to its high specificity, great attention has been paid to the hybridization-based DNA sensor. Among the DNA hybridization-based biosensors, field effect transistor (FET) based sensors are of interest due to label-free use and its rapidness in detection. What is more, the FET-based biosensors are compatible with microfluidic system. However, in spite of this importance, research on the FET-based biosensor is still at its rudimentary stage.

In this work, we have fabricated AlGaN/GaN high electron mobility transistor (HEMT) based DNA sensors and its DNA hybridization characteristics were investigated. We have used amine-based chemistry for DNA immobilization.

UV-VIS absorbance spectroscopy measurement was performed to verify the hybridization of the DNA (Figure 1). The characteristic peaks at around 260 nm indicate the hybridization and denaturation of the DNA strands, which corresponds to hypochromic and hyperchromic effect.

The AlGaN/GaN HEMT was constructed using standard HEMT fabrication technique. After the wire bonding to the device, photopatternable silicone was applied for device encapsulation. The packaged/wire-bonded devices are shown in Figure 2.

Time-resolved evolution of the transistor drain current is shown in Figure 3. Initially, slight reduction in drain current was observed upon the application of the 3 base pair (bp) mismatched target. Substantial decrease of the drain current (around 25 μA) was detected upon introduction of the complementary target DNA to the same device, which is an indication of the hybridization of DNA.

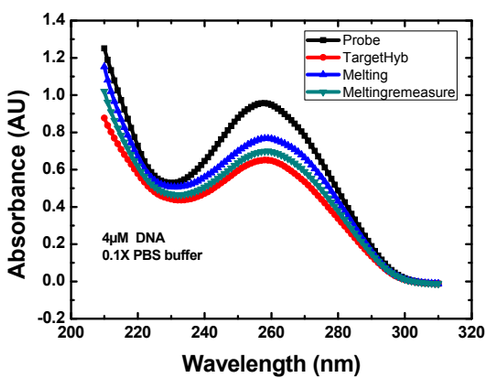

Fig. 1: UV-Vis absorbance spectrum of the single strand DNA, hybridized DNA and the effect of heat denaturation.

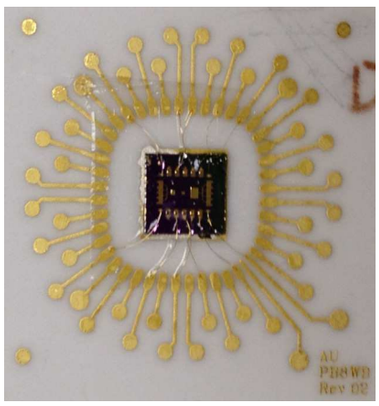

Fig. 2: Photograph of the packaged sensor and transistor for the detection of DNA.

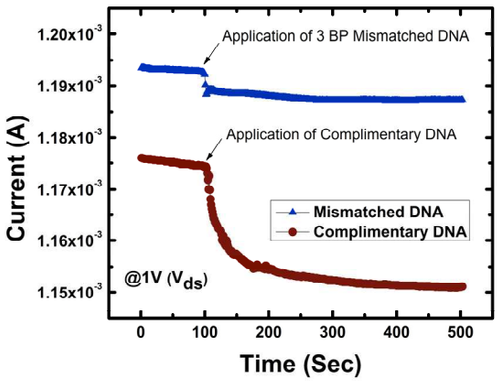

Fig. 3: Current vs. time hybridization measurements of 3 base pair mismatched and complimentary 1 μM target DNA.

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