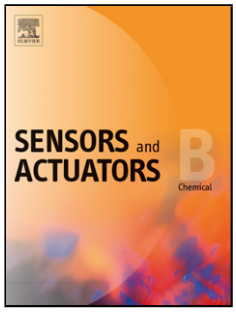

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Highly Sensitive and Rapid MicroRNA Detection for Cardiovascular Diseases with Electrical Double Layer (EDL) Gated AlGaN/GaN High Electron Mobility Transistors

Yen-Wen Chen[a], Wen-Che Kuo[a], Tze-Yu Dai[a], Chen-Pin Hsu[a], Indu Sarangadharan[a], Anil Kumar Pulikkathodi[a], Hsin-Li Wang[a], Revathi Sukesan[a], Hsing-You Lin[a], Kun-Wei Kao[c], Chia-Liang Hsu[c], Chih-Chen Chen[a,b], Yu-Lin Wang[a,b*]

[a]Institute of Nanoengineering and Microsystems, National Tsing Hua University, Hsinchu 300, Taiwan, R.O.C.

[b]Department of Power Mechanical Engineering, National Tsing Hua University, Hsinchu 300, Taiwan, R.O.C.

[c]Epistar Corp., Hsinchu 300, Taiwan, R.O.C.

Abstract

This study reports the development of an efficient and sensitive method to directly sense microRNA (miRNA) in high ionic strength solutions with the use of electrical double layer (EDL) gated AlGaN/GaN high electron mobility transistor (HEMT). This FET structure uses a complementary DNA probe functionalized gate electrode which is separated from the transistor channel. In this research, we focus on the detection of miRNA samples, miR-126, miR-208a and miR-21 which are biomarkers of cardiovascular diseases (CVD). The sensor has a dynamic range that is comparable to the clinically relevant concentration range with a detection limit as low as 1 fM. Selectivity of the sensor is demonstrated by evaluating sensor response at fully complementary and slightly mismatched sequences. The miniaturized sensor can be used in point of care or homecare diagnostics for rapid miRNA detection to evaluate CVDs at an early stage.

Keywords: AlGaN/GaN HEMT; electrical double layer; miRNA; cardiovascular diseases

1. Introduction

Recently, cardiovascular diseases (CVDs) have become the number one cause of death worldwide. In 2012 alone, 17.5 million people have died from CVDs, which represents 31% of all global deaths making it a worldwide burden. CVDs include coronary heart disease (heart muscle), cerebrovascular disease (brain), peripheral arterial disease (leg and arm), rheumatic heart disease (heart valve) and congenital heart disease (intrinsic). Heart attack and stroke are all caused from the blockage in the blood vessels to various organs in the body [1]. The risk factors for CVD vary from age, tobacco usage, genetics, diet and work pressure. Recent