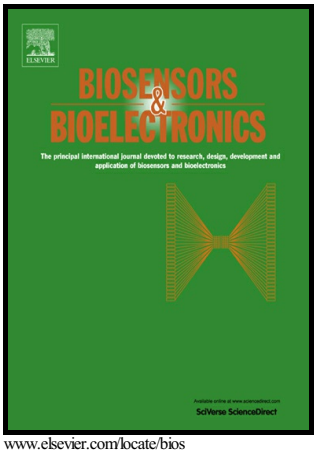

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PII: S0956-5663(16)30145-2
DOI: http://dx.doi.org/10.1016/j.bios.2016.02.040
Reference: BIOS8472

To appear in: *Biosensors and Bioelectronic*

Received date: 4 January 2016
Revised date: 12 February 2016
Accepted date: 14 February 2016

Cite this article as: Saswat Mishra, Darius Saadat, Ohjin Kwon, Yongkuk Lee Woon-Seop Choi, Jong-Hoon Kim and Woon-Hong Yeo, Recent advances in salivary cancer diagnostics enabled by biosensors and bioelectronics, *Biosensor and Bioelectronic,* http://dx.doi.org/10.1016/j.bios.2016.02.040

Recent advances in salivary cancer diagnostics enabled by biosensors and bioelectronics

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Abstract
There is a high demand for a non-invasive, rapid, and highly accurate tool for disease diagnostics. Recently, saliva based diagnostics for the detection of specific biomarkers has drawn significant attention since the sample extraction is simple, cost-effective, and precise. Compared to blood, saliva contains a similar variety of DNA, RNA, proteins, metabolites, and microbiota that can be compiled into a multiplex of cancer detection markers. The salivary diagnostic method holds great potential for early-stage cancer diagnostics without any complicated and expensive procedures. Here, we review various cancer biomarkers in saliva and compare the biomarkers efficacy with traditional diagnostics and state-of-the-art bioelectronics. We summarize biomarkers in four major groups: genomics, transcriptomics, proteomics, and metabolomics/microbiota. Representative bioelectronic systems for each group are summarized based on various stages of a cancer. Systematic study of oxidative stress establishes the relationship between macromolecules and cancer biomarkers in saliva. We also introduce the most recent examples of salivary diagnostic electronics based on nanotechnologies that can offer rapid, yet highly accurate detection of biomarkers. A concluding section highlights areas of opportunity in the further development and applications of these technologies.

Keywords
salivary diagnostics, cancer biomarkers, biosensors, and bioelectronics.