

Development of Microcantilever Sensors for Liver Cancer Detection

Jingjing Wang^{1,2}, Yinfang Zhu^{1,2}, Jinying Zhang¹ and Jinling Yang^{1,2*}

¹Institute of Semiconductors, Chinese Academy of Sciences, Beijing 100083, P. R. China

²State Key Laboratory of Transducer Technology, Shanghai 200050, P. R. China

* **Corresponding author:** Jinling Yang, Institute of Semiconductors, Chinese Academy of Sciences, Qinghua Donglu A 35, Beijing 100083, P. R. China, Tel: +86 10 8230 4700; Fax: 86 10 8230 5141; E-mail: jlyang@semi.ac.cn

Rec Date: Nov 18, 2015; Acc Date: M

unexpected error"An accurate theoretical model is needed to take the effect of change into account in the local immobilization approach" A microcantilever was designed in the free end of the cantilever for local antibody immobilization in our work, thus the adsorption-induced variation of stiffness can be dramatically reduced compared to that caused by adsorption of the whole layer. In addition, an analytical model has been established to eliminate the effect of adsorption-induced layer stiffness change and has been applied to precise assay detection of cancer biomarker AP, the detected AP antigen assay results are close to the calculated one. The sensitivity is two orders of magnitude better than the value by the fully antibody-immobilized cantilever sensor. These approaches will promote clinical application of the cantilever sensors in early diagnosis of cancer.

Keywords: 0(06 FDQWLOHYHU /LYHU FDQFHU ELRPDUNHU 0DVV
GHWHFWRQ \$GWRULS\WKLQJHQGXFHG

, QWURGXFWLRQ

0LFURFDQWLOHYHU EDVHG ELRVHQVVRUV KDYH EHHQ ZLGHO\ XVHG WR GHWHFWRQ
'1\$ 51\$ DQWLJHQ HQ]\PH P\FRWR[LQ DQG GUXJ PRQLWRULQJ > @
1RZDGD\U UHVHDFKHUV KDYH EHHQ DWUDFWHG WR FRQWULEXWH WR HDUO\
GLDJQRVLV RI FDQFHU EDVHG RQ PLFURFDQWLOHYHU ELRVHQVVRUV GXH WR LWV K
VHQVLWLYLW\ UHOLDELOLW\ DQG ORZ FRVW ,W KDV EHHQ GHPRQVUDWHG W
PLFURFDQWLOHYHU KDV JUHDW SRWHQWLDO IRU FOLQLFDO DSSOLFDWRQ LQ H
GLDJQRVLV RI FDQFHU

*HQHUDOO\ FDQWLOHYHUV KDYH WZR ZRUNLQJ PRGHV VWDWLF PRGH DQG
G\QDPLF PRGH ,Q G\QDPLF PRGH WKH OHFVWHU
WKXV WKH UHVRQDULW\ UHTXHQF\ RQ WKH YDULDWRQ RI
PDVV P +RZHYHU WKH GHWHFWRQ HUURU ZDV VXEVWDQWLDO GXH WR WKH
DGVRUSWRQ LQGXFHG VXUIDFH VWUHV > @ 6RPH UHVHDFK JURXSV KDYH
IRXQG WKH LQVWLWXWLRQ WKH PLFURFDQWLOHYHU WKH PLFURFDQWLOHYHU
WKH PHDVXUHG LQVWLWXWLRQ WKH PLFURFDQWLOHYHU WKH PLFURFDQWLOHYHU
FDOFXODWHG [SN] PHQWDO UHVXOWV LQGLFDWHG WKDW WKH FKDQJH
RI OHFVWHU VWUHV DQ LPSRUWDQV LQ WKH IUHTXHQF\
WR DGVRUSWRQ RI ELRPROHFXOHV RQ WKH FDQWLOHYHU > @

H HVHW VXUIDFH VWUHV RQ WKH FDQWLOHYHU IUHTXHQF\ KDV EHHQ
LQVWLWXWLRQ ZLWK WKHRUHWLFDQ DQG H[SHULPHQWDO VWXGLHV +ZDQJ HW
UHSRUWHG WKDW GXH WR WKH MRLQW DFWLRQ RI PDVV ORDGLQJ DQG VXUIDFH
FDXVHG E\ PROHFXODU @PEIU

5HIHUHQFHV

```

:DJJ 63 :DJJ -- =KX <) <DJJ -/ <DJJ )+
OLYHU FDQFHU ELRPDUNHU GHWHFWLRQ ZLV
+XEHU ) /DJJ +3 %DFNPDQQ 1 5LPROGL '6HVEHU SHVHDFKUHFW
GHWHFWLRQ RI D %5$) PXWDWLRQ LQ WRWDQ 50$ IURP /PHOQRP FHOQYHXV LQJLP 76
FDQWLOHYHU DUUD\ 1DW 1DQR QDQRFDQWLOHYHU GHYLFHV DQG \VWHPV IR
/X / 6L -& *DR =) =KDQJ < /HL -/ HW DO $QDO &KHPO\ VHOHFWLYH DQG
VHQVLWLYH HOHFWURFKHPLFDO ELRVHQVURU $REU $FRWEDVHG %RQW KH GXDQ YWUDXWU '
LQWHJUDWLRQ WKH FRIDFWRU GSHQGQHW GHWDFWLRQ LQ DWLQR KUHDFWFBQ ZLWKYHUQI
FOHDY $PH DPSO HQHFWURFKHPLFDO GHWHFWLRQ LQ WLVHQVURU $SSO QRI
%LRHOHFWURQLFV XQQDW :DUPDFN 5 &KHQ * $HODORQ DPELHG
3DUN - .DUVWHQ 6/ 1LVKLG 6 .DZDNDWVX LQG XHGHFWLRQ $SSO LFDWHRP LFURVFRSH
RI D QHZ PLFURFDQWLOHYHU ELRVHQVURU UHFRQDWLQJ DW WKH DLU OLTXLG LQWHUIDFH
IRU GLUHFW LQVXOLQ GHWHFWLRQ DQG FRQVXLQRY PRQWRU LQ RI HQDQW 6
UHDFWLRQV /DE RQ D &KLS 6QLV (GT VLVW 6LPX 8I RRDQW 6
%DL ; +RX + =KDQJ % 7DQJ - /DEHO IUHH GHWHFWLRQ RI NDQDP\ FLQ
XVLQJ DSWDPHU EDVHG FDQWLOHYHU DUUD\ VHQVURU %LRVHQVURU DQG
%LRHOHFWURQLFV BRQ 3 XVPKQ 3 IDERN $PEURVFK 'UDI
+XDQJ /6 3KHDQSDQLWSRUQ < <HQ <. &KDQVRSWLRQ HWWK RSKHQH RQ &X DV
'HWHFWLRQ RI WKH DQWLHSLOHSWLF GUXJ SKHQ\WRLQ XVLQJ D VLQJOH IUHH VWDQGLQJ
SLHJRUVLVWLYH PLFURFDQWLOHYHU IRU <L' XDP + WLF GUXJ PRQWRU LQ QGXFHG
%LRVHQVURU DQG %LRHOHFWURQLFV DQGLWV GHIRUPDWLRQ DQG IUHTXHQF\ RI
-RKQVRQ %1 0XWKDUDVDQ 5 %LRVHQVURU XVLQJ \QDPLF PRGH
FDQWLOHYHU VHQVURU D UHYLHZ %LRVHQVURU %LRHOHFWURU
/HH -+ .LP 76 <RRQHFW PDVV DQG VWUHVVRU IDPHRQVHW DQVRODQFH IUHTXHQF\ RI
IUHTXHQF\ IXQFWLRQDOLJHG 3E =UOP 7L 2 WKLQVSHFWUD RI YDQ GHU :DDOV
PLFURFDQWLOHYHU IRU WKH GHWHFWLRQ RI & UHDFWLYH SURYDLQ 6 $SSO (KW <) <
LPPRELOLJHG DQWLERG\ IR
*XSWD $. 1DLU 35 $NLQ ' /DGLVFK 05 %UR\OHV 6 HW DQHPDQGXFDQJ 63 x:DJJ ;
$QRPDORXV UHVRQDQFH LQ D QDQRPHFKDQLFDO ELRVHQVURU $SSO VHQVURU IRU PXO
.((( w w
+ZDQJ .6 (RP . /HH -+ &KXQ ': &KD %+ HW DO 'RPLQDQW
VXUIDFH VWUHVVRU GULYHQ E\ ELRPROHFXODU LQWHUDFWLRQV LQ WKH G\QDPLFDO
UHVSQRVH RI QDQRPHFKDQLFDO PLFURFDQWLOHYHU $SSO 3K\ /HW
:DJJ ') 2QR 7 (VDVHUPDWUHDWPHQWV DQG JDV
DGVRULSWLHQHQDQRPHFKDQLFV RI XOWUD WKLQ VLOLFQ UHVRQDWURU
IRU XOWLPDWH VHQVLQJ 1DQRWHFKQRORJ\

```