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ZnO Based SAW and FBAR Devices for Bio-Sensing Applications

A.J. Flewitt[1], J.K. Luo[1,2],Y.Q. Fu[1,3], L.Garcia-Gancedo[1], X.Y. Du[1], J.R. Lu[4], X.B.Zhao[4], E. Iborra[5], M.Ramos[5]and W.I. Milne[1]

1.Electrical Division, Engineering Department, University of Cambridge, J.J. Thomson Avenue, CB3 0FA, UK

2. Institute of Renewable Energy and Environment Technology, Bolton University, Bolton, BL3 5AB,UK

3. Thin Film Centre, Scottish Universities Physics Alliance (SUPA), University of West of Scotland, Paisley, PA1 2BE, UK

4.Biological Physics Group, School of Physics & Astronomy, University of Manchester, Oxford Road, ManchesterM13 9PL, UK

5. Dpto. Tecnología Electrónica,E.T.S.I. de Telecomunicación, Universidad Politécnica de Madrid, 28040, Madrid, Spain

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Abstract

ZnO thin film based surface and bulk acoustic wave devices are reviewed in this paper. The films were initially produced using a standard RF sputtering technique. However in order to produce lower stress, smoother films at low temperatures, a novel High Target Utilisation Sputtering (HiTUS) system has also been utilised. The ZnO acoustic devices have been used to move, mix, pump, eject and atomise liquids depending upon the amplitude of the signal and the condition of the surface. Such Surface Acoustic Wave (SAW) devices have also been shown to act as bio sensors but more sensitive detection is obtainable by the use of Film Bulk Acoustic Resonators (FBARs), the design and operation of which are described at the end of this review. Whilst the interaction of the acoustic wave with a fluid on its surface allows its rheological properties to be measured, such as viscosity, it is speculated that the combination of SAW and FBAR technologies may also provide new opportunities for rheometry on the microscale where fluids generally follow a non-Newtonian behaviour.

1 Introduction: Over the past several years various sensing platforms have been investigated for use in medical analysis and diagnosis applications. One such platform utilises a lab-on-a-chip (LOC)which consists of a number of devices which perform a series of laboratory functions on a single chip. These typically consist of two main components: one which deals with the micro-fluidics aspects including filtering, mixing and sorting and the other involves sensing or detection[1, 2]. The mechanisms used for the sensing and microfluidics are in general very different making integration of the devices difficult.Microfluidics can include microchannels, microvalves, microfilters,micropumps,micromixers and even microreactors[3-6] The bio-sensing can be based upon optical detection[7], thermal detection[8], electrochemical detection[9], ion sensitive FET[10]or resonant detection[11]. The latter technique is the one on which we have chosen to focus on due to its potential for obtaining sensors with exceptionally high sensitivity on a small form factor. An example of such a sensor is aquartz crystal microbalance sensor (QCM)[12]. Thus we have investigatedthe use of Film