GUEST EDITORIAL

SMEOS 2011 (SENSORS, MEMS AND ELECTRO-OPTIC SYSTEMS)

This special issue of the SAIEE Africa Research Journal is devoted to selected papers from the SMEOS 2011 (Sensors, MEMS and Electro-Optic Systems) Conference which was held in Berg-en-Dal, Kruger National Park, South Africa from 19 to 21 September 2011. The aim of SMEOS 2011 was to establish a forum for academia, research institutions and industry working in the field of sensors, MEMS and electro-optical systems, to share their relevant research and development ideas. Each paper presented at the conference was double-blind reviewed by at least two reviewers. Reviewers could recommend a reviewed paper to the technical chair for publication in this special issue, and a total of eleven papers eventually passed this review process.

Five of the papers discuss the integration of additional functionality into the existing CMOS technology and the vacuum packaging of some these devices. Two papers address the issue of integrating thermal MEMS devices onto a CMOS chip, a third paper investigates the wafer level packaging of CMOS MEMS devices, and two papers report on the properties and application of optical devices in standard CMOS technology.

In the paper by Maclean et al, "Optimisation of CMOS compatible microbolometer device performance", the design, simulation and characterisation of CMOS microbolometers are investigated in order to optimise the electro-thermal properties of the devices. The paper by Schoeman and du Plessis, "Characterisation of the electrical response of a novel dual element thermistor for low frequency applications", also deals with thermal elements integrated onto a CMOS chip, but in this case the interaction between two thermal elements in close proximity is being investigated. These novel devices can be used in very low frequency signal processing applications as a result of the quite long thermal time constants. In the paper by Versteeg et al, "Wafer level packaging with wedge seal method", a novel vacuum tight seal referred to as the wedge seal method is proposed. The seal consists of a silicon wedge forced into a pliable material (typically a metal) that is attached to the component wafer. The wedge-seal addresses some of the requirements of CMOS micro-bolometer packaging in that it provides a vacuum tight seal at low temperatures with tolerance to surface finish and topography.

The paper by Bogalecki et al, "Spectral measurement and analysis of silicon CMOS light sources", reports on the spectral emission from CMOS based pn junctions. Junctions in reverse bias, forward bias and in punch-through conditions are investigated, with the surprising result that a fairly wide range of wavelengths are emitted. It is indeed speculated that intra-conduction-band (c-c) electron (e-) transitions seem to be the dominant physical mechanism responsible for the wide spectrum in the avalanching and punch-through devices. One application that has already been achieved is an all silicon optical data transmission system, reported by Goosen et al in their paper "CMOS avalanche electroluminescence applications – microdisplay and high speed data communication". This paper describes a 10 Mb/s optical data link using CMOS light sources, with a bit error rate better than 10-12. Since the devices also emit in the visible range, a novel CMOS dot matrix microdisplay is also described.

Three papers report on research activities at the National Metrology Institute of South Africa (NMISA). The first paper by Burger et al, "Ab initio frequency measurement and characterisation of frequency doubled fibre laser utilised for precision oscillators" describes the first ab initio measurement of an unknown optical frequency utilising the Ti:Sapphire-laser based optical frequency comb at NMISA. It is shown that this measurement methodology can be successfully applied to specifically relatively noisy lasers. In a second paper by Burger et al, "Methodology for in situ characterisation of a highly birefringent photonic crystal fibre for supercontinuum generation", a novel methodology for precisely determining the eigenaxes and effective twist of a solid-core polarisation maintaining fibre with a slightly elliptical effective core in an experimental setup with an ultrashort pulse laser is presented. In a third paper by Kritzinger et al, "Digital design of broadband long-period fibre gratings by an inverse scattering algorithm with flip-flop optimisation", a discrete inverse scattering method, known as layer-peeling, is used to synthesise a LPFG (long-period fibre grating) from a desired complex spectrum by a direct solution of the coupled-mode equations, while simultaneously determining the physical properties of the layered structure. Possible applications are also discussed where optimised broadband LPFGs could be utilised in the field of telecommunications and sensing.

A very interesting paper by Hugo et al originating from the Materials Science and Manufacturing Division at the CSIR, "A lensless, automated microscope for disease diagnostics", presents a digital in-line holographic microscope (DIHM) platform to be used with image processing and classification algorithms to provide a low cost, portable and automated microscope. Initial results show that the images obtained using the DIHM platform are similar to those obtained using a conventional bright field microscope. This work will be targeted towards the implementation of an automated full blood count, which could provide resource limited areas with improved healthcare facilities and reduced diagnosis times at a low cost.

Strever et al in their paper "Optical and thermal applications in grapevine (vitis vinifera l.) research – an overview and some novel approaches" describe various optical and thermal applications in grapevine research to quantify the light and temperature regime around a grape bunch. Techniques include temperature measurement techniques (thermocouples and thermal imaging) as well as methods to quantify light quantity (hemispherical photography) as well as light quality (spectro-radiometric applications) around a grape bunch.

The last paper deals with infrared detectors. In the paper "Growth and characterisation of InAs photodetectors for MWIR applications" by Wagener et al, the development of InAs photodiode structures grown by metal-organic vapour phase epitaxy and processed using conventional photolithography techniques are discussed. Due to the narrow band gap of these materials, the detectivity of the devices is often limited by the junction leakage currents. Various contributions to the leakage current and photo-response have been analysed.

Prof. Monuko du Plessis
Guest Editor