2019 國際產業可靠度工程研討會

International Industrial Reliability Workshop (IIRW)

日期：2019 年 4 月 30 日星期二

地點：長庚大學第二醫學大樓 B1 會議廳二

時間	內容	主講人
9:30-10:00	來賓簽到	
10:00-10:15	長官致詞	許光宏副校長
10:15-10:30	產業聯盟介紹	陳始明主任
10:30-10:45	來賓致詞	英飛凌科技股份有限公司-總經理
10:45-11:00	商業夥伴簽約儀式	
11:00-11:30	主題演講：Quality Method for Product Reliability Assurance	Prof Cher Ming Tan, CGU
11:30:12:00	主題演講：Systems Monitoring and Personalized Health Management	Prof Tsui Kwok. L, City Univ
12:00-1300	午餐	
13:00-13:30	主題演講：Reliability Prediction of Current and Future Nanoelectronic Devices – Trends and Challenges	Prof Nagarajan Raghavan, SUTD
13:30-14:00	主題演講：Materials Forensics and Analysis：From Stolen Gold Bars to Fracturing Lead-Free-Tin Solders	Prof Tok Eng Soon, NUS
14:00-15:00	台灣工業可靠性面臨的挑戰產業討論	
15:00-15:30	午茶	
15:30-16:00	參觀可靠度科學技術研究中心	

主題演講一：

Quality Method for Product Reliability Assurance

Primary Presenter: Cherming Tan – Director, Chang Gung University

Many current quality methodologies employed in manufacturing can ensure high yield and products meeting the customers' specifications upon shipment. However, how quickly the performances of the products degrade in the field affect customers' satisfaction, and most current quality methodologies cannot ensure this. A good example is the Note 7 lithium ion battery issued in early 2017, where a very small percentage of the battery degraded much faster than expected, resulting in a big loss to the company. Generally, such degradation can be known only after the products are put in use, and quality methodologies can only ensure zero-time conformity. In this session, a quality method that can also ensure product reliability will be presented with real case examples: power semiconductor devices for automotive applications; encapsulant degradation for moisture resistance in electronic devices; and lithium ion batteries. This is a method where we bring the product future to the current for quality assurance.

Learning Objectives:

Learn about this back to the future quality assurance method.
Discover how one can have a good quality product but its reliability is poor, and vice versa, and thus become aware of the
difference between standard quality and reliability assurance methods.
Understand the concept of safety margin and loading roughness so that the necessity to include product performance
variation due to manufacturing in design-for-reliability method can be appreciated.

主題演講二：

Systems Monitoring and Personalized Health Management

Kwok L. Tsui

School of Data Science
Dept. of Systems Engineering & Engineering Management
City University of Hong Kong

Abstract

Due to the advancement of computation power, sensor technologies, and data collection devices, the field of systems monitoring and health management have been evolved over the past several decades under different names and application domains, such as statistical process control (SPC), process monitoring, health surveillance, prognostics and health management (PHM), engineering asset management (EAM), personalized medicine, etc. There are tremendous opportunities in interdisciplinary research of system monitoring through integration of SPC, system informatics, data analytics, PHM, and personalized health management. In this talk we will present our views and experience in the evolution of systems monitoring, challenges and opportunities, and applications in machine systems health management as well as human health management.

Bio: Kwok L Tsui is chair professor in the School of Data Science and the Department of Systems Engineering and Engineering Management at City University of Hong Kong. Prior to the current position, Dr. Tsui has been professor/associate professor in the School of Industrial and Systems Engineering at Georgia Institute of Technology in 1990-2011; and member of technical staff in the Quality Assurance Center at AT&T Bell Labs in 1986-1990. He received his Ph.D. in Statistics from the University of Wisconsin at Madison. Tsui was a recipient of the National Science Foundation Young Investigator Award. He is Fellow of the American Statistical Association, American Society for Quality, International Society of Engineering Asset Management, and Hong Kong Institution of Engineers; elected council member of International Statistical Institute; and U.S. representative to the ISO Technical Committee on Statistical Methods. Tsui was Chair of the INFORMS Section on Quality, Statistics, and Reliability and the Founding Chair of the INFORMS Section on Data Mining. Tsui's current research interests include data mining, surveillance in healthcare and public health, prognostics and systems health management, calibration and validation of computer models, process control and monitoring, and robust design and Taguchi methods.

主題演講三：

Reliability Prediction of Current and Future Nanoelectronic Devices – Trends and Challenges

ABSTRACT – With the continuous evolution of semiconductor technology towards the sub 5-nm technology node and the changing material, device, operational and geometrical landscape of these devices, the prediction of lifetime of these devices has become a challenge as defect nucleation, growth and eventual breakdown of the devices show more complex trend of failure due to non-random spatio-temporal kinetics. In this talk, we will present examples of this complexity by focusing on dielectric breakdown in the front-end, back-end and middle of line interconnects and how the understanding of breakdown has evolved over different semiconductor technology nodes, providing some insights into the future of reliability science and engineering for semiconductor technology.

BIOGRAPHY – Nagarajan Raghavan is an Assistant Professor at the Singapore University of Technology and Design (SUTD) in the Engineering Product Development pillar. Prior to this, he was a postdoctoral fellow at the Massachusetts Institute of Technology (MIT) in Boston and at IMEC in Belgium, in joint association with the Katholieke Universiteit Leuven (KUL). He obtained his Ph.D. (Microelectronics, 2012) at the Division of Microelectronics, Nanyang Technological University (NTU), Singapore. His work focuses on statistical characterization and reliability modeling of dielectric breakdown and resistance switching in novel high-κ dielectric material based logic and memory device stacks. His other research interests include random telegraph noise, prognostics and health management for electronic devices, design for reliability and uncertainty quantification. He is the recipient of the IEEE EDS Early Career Award for 2016, Asia-Pacific recipient for the IEEE EDS PhD Student Fellowship in 2011 and the IEEE Reliability Society Graduate Scholarship Award in 2008. To date, he has authored / co-authored more than 150 international peer-reviewed publications and five invited book chapters as well. He is serving on the review committee for various IEEE journals and conferences including IRPS, INEC, IIRW, IPFA and ESREF. He is currently a Member of IEEE (2005-present) and was an invited member of the IEEE GOLD committee (2012-2014).

主題演講四：

Materials Forensics and Analysis:
From Stolen Gold Bars to Fracturing Lead-Free-Tin Solders

Eng Soon TOK

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ABSTRACT
In this talk, the case associated with stolen gold bars allows us to examine some aspects of materials characterization and analysis associated with the use of non-destructive analytical methodology in the authentication of recovered merchandize that were initially stolen. The burden of proof that was needed within scientific certainty was to establish that there was no mistake in identify that the recovered items were made of nothing else but Gold, as demanded by all parties including the victim. This incident which I will share, illustrate the principle and context how analysis methods and techniques that were chosen for this task addresses the three basic S's and the three basic R's in performing material analysis, characterization and root cause evaluation. The three "S's" being Sensitivity, Selectivity and Suitability while the three "R's" being Repeatability, Reproducibility and Reliability. Next, we will examine the other approach, which is associated with the used of invasive and destructive analytical methodology to resolve the curious case associated with fracturing at Lead-Free-Tin Solders ball. Our client then were puzzled as to why the crack/fracture occurs at the main solder region, away from the expected failure at IMC-solder joints during drop tests of their product. The formation of intermetallic compounds (IMC) such as Cu6Sn5 at the Lead free Tin Solder (SAC305)-Cu bond pad interface are very well described in the literature. Cross-section analysis of the solder joint have shown that these IMC exhibits finger-like morphologies. Their thickness and phases are also known to be very sensitive to reflow processes and aging. While these features are well annotated at the interface, the presence of long needle-like features arising from the interface as well as those appearing to be "floating" in the solder material away from the interface are not as well captured nor their origin authenticated in any significant details. In this context, we therefore have to re-examined this well know interface and we did so using a combination of cross sectional analysis together with Normaksi Optical Microscopy and SEM-EDX imaging, in an attempt to probe and authenticate its origin. By carefully sectioning the solder ball by polishing, we found that these features while sharing similar morphology are not at all Ag3Sn compounds as it often assumed. These floating features in fact originates from the Solder-Cu interface. The presence of large IMC in the main solder region away from the interface have affected its ductility by making it more brittle in the process. This in part account for the primary facture being at solder ball and away from the IMC-solder joints in these industrial samples.