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MATERIALS SCIENCE & ENGINEERING DISTINGUISHED SEMINAR SERIES

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11:00AM — 12:00PM

Research 1

Room 101

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Biodegradable Microsystems: Physical Sensors, Chemical Sensors, and Power Sources

This talk will discuss the design, fabrication, and application of biodegradable microfabricated devices and systems. Such microsystems, comprised of materials that ultimately degrade with time, may have application in areas such as biomedical implants for the treatment of acute disease, or environmental sensors that do not persist in the environment once their sensing capabilities have been exhausted.

In addition to the relatively restricted materials set appropriate for these devices, the development of new fabrication technologies may also be required, since the degradable materials often cannot withstand the harsh processing conditions typically used in traditional MEMS fabrication. In spite of these materials and processing limitations, a surprising range of functionality can be achieved.

Biodegradable microsystems typically require (at a minimum) conductors, structural materials, and dielectrics to function. Zinc, magnesium, and zinc-iron couples are investigated as conductor materials, and biodegradable polymers are investigated as dielectrics and structural materials. Methods to design degradation rates of these materials will be discussed. Unconventional MEMS fabrication technologies, including embossing and multi-layer folding were combined with traditional techniques to fabricate functional devices.

After a discussion of these materials and techniques, three examples of transient devices exploiting these techniques will be presented: wireless RF-powered pressure sensors, self-powered chemical sensors, and batteries/power sources that draw electrolyte resources from the environment in which they are embedded. Ranges of operation and application scenarios for these devices will also be discussed.

Biography: **Mark G. Allen** received the B.A. degree in chemistry, the B.S.E. degree in chemical engineering, and the B.S.E. degree in electrical engineering from the University of Pennsylvania, Philadelphia, and the S.M. and Ph.D. degrees from Massachusetts Institute of Technology, Cambridge. In 1989 he joined the faculty of the School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, ultimately holding the rank of Regents' Professor and the J.M. Pettit Professorship in Microelectronics. In 2013 he left Georgia Tech to become the Alfred Fitler Moore Professor of Electrical and Systems Engineering and Scientific Director of the Singh Center for Nanotechnology at the University of Pennsylvania. His research interests are in the development and the application of new micro- and nanofabrication technologies, as well as MEMS. He has held the posts of Editor-in-Chief of the Journal of Micromechanics and Microengineering, co-chair of the IEEE MEMS Conference, chair of the Solid State Microsystems Conference ('Hilton Head'), and is co-founder of multiple MEMS companies, including Cardiomems, Axion Biosystems, and Enachip. Professor Allen received the 2016 IEEE Daniel P. Noble Award for contributions to research and development, clinical translation, and commercialization of biomedical microsystems, and the 2020 IEEE Benjamin Franklin Key Award. He is a Fellow of the IEEE and a Fellow of the National Academy of Inventors.