“Energy Considerations and Self-Powered Devices”

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This tutorial will investigate some of the energy considerations that go into making self-powered systems. “Self-powered” implies that enough energy is extracted from the immediate surroundings for the device to perform its function. This can be applied to numerous applications ranging from unattended sensors and industrial sensor application where the energy is extracted from machinery. However to focus the discussion the tutorial will concentrate on self powered systems where the power is obtained from the human body and applied to physiological and environmental sensing. The possibility of self-powered sensors are enabled by the rapid intersection of two technology trends that have the potential to change the way we examine relationships between human health and the environment. The first trend is the decreasing amount of power required to perform analog to digital conversion, perform computations on that information, and wirelessly transmit results of that computation. The second trend is the increase in efficiency of energy harvesting and non-battery energy storage. Once these trends intersect and the amount of energy harvested from the human body exceeds the power consumed by a nano-system, new technology pathways open up where self-powered nano systems can be designed to interact with the human body and the environment in new ways. The ability to provide correlated measurements between individuals and the personal exposures they receive in their daily micro environments provide new opportunities to improve the human condition.

John Muth received a B.S. in Applied Engineering Physics from Cornell in 1988, served as a fast attack nuclear submarine officer 1988-1993. He received a PhD in Physics from NC State University in 1998. He is presently a full professor at North Carolina State University in Electrical and Computer Engineering and the Deputy Director of the National Science Foundation Nanosystems Engineering Research Center for Advanced Self-powered Systems of Integrated Sensor Technologies (ASSIST). He has worked on a variety of projects including wide band gap materials and metal oxides for device applications, as well as InGaZnO transistors, and underwater optical communication systems. His present research interests include applying nanotechnology at the systems level with an emphasis on novel optoelectronic materials, ultra-low power sensors and incorporating them into flexible and textile electronics. By monitoring human physiological and environmental parameters in a low power, wearable form factors he hopes to obtain a better understanding of how individuals interact with the microenvironments and stresses encountered in daily life.