## Electronics for All

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We live in the age of the information where electronics play a critical role in our daily life. Traditional approaches for innovation in electronics have been inspired by Moore's Law: performance with affordability. By leveraging suitable material properties of silicon, we have perfected complementary metal oxide semiconductor (CMOS) technology to achieve high performance, energy efficiency and ultra-large scale integration density in CMOS electronics. Moving forward as we embrace the Internet of Everything (IoE) where people, process, device and data will be seamlessly connected – what would be the attributes of the electronics? What potential applications can augment the quality of our life, which do not exist today? Is it possible to bring tomorrow's applications to today's society?

These questions have influenced my research. My continuing exploration suggests electronics in future will be ubiquitous in our life and seamlessly connected through internet. The attributes of the future generation of physical electronics will include: (i) dynamic performance; (ii) ultra-low to self-powered operation (i.e. co-integration of energy harvesters); (iii) robust communication; (iv) interactive (data acquisition through sensors, data processing, storage, communication and decision execution through actuators will be heterogeneously integrated); (v) democratized (easy to understand, simple to implement, use and affordable) and (vii) free form (physically flexible, stretchable and reconfigurable to conform to the soft tissue, irregular contour and asymmetric skin surfaces of living beings: human, plants and animals).

While traditional CMOS industries have been advancing the classical features of performance, power consumption and scaling, the academic community has specifically focused on materials based innovation and low-cost fabrication processes. Ironically traditional CMOS materials like silicon, silicon germanium, germanium, III-V, gallium nitride, etc. are rigid and bulky; conversely emerging materials are still in the exploration phase and far from manufacturability for broad range of electronics. Thus, a balanced blend of scientific discovery and engineering innovation is an absolute necessity today. Hence, I have focused on building that bridge by rational design of materials, processes and devices to develop robust manufacturing processes for the future electronic systems focused on smart living and a sustainable future. In my talk, I will elaborate on manufacturability of this new class of electronics.

**Bio:** Dr. Muhammad Mustafa Hussain (PhD, ECE, UT Austin, Dec 2005), before joining KAUST was Program Manager in SEMATECH, Austin. His program was funded by DARPA NEMS, CERA and STEEP programs. A regular panelist of US NSF grants reviewing committees, Dr. Hussain is the *Fellow of American Physical Society (APS), Institute of Physics, UK and Institute of Nanotechnology, UK, IEEE Electron Devices Society Distinguished Lecturer, Editor-in-Chief of Applied Nanoscience (Springer-Nature), Editor of IEEE Transactions on Electron Devices,* and an *IEEE Senior Member*. He has authored 265+ research papers, 50+ issued and pending US patents. His students are serving as faculty and researchers in MIT Media Lab, UC Berkeley, Harvard, UCLA, Yale, Purdue, TSMC, KACST, KFUPM, KAU, and DOW Chemicals. Scientific American has listed his research as one of the Top 10 World Changing Ideas of 2014. Applied Physics Letters selected his paper as one of the Top Feature Articles of 2015. He and his students have received 40 research awards including IEEE Outstanding Individual Achievement Award 2016, Outstanding Young Texas Exes Award 2015 DOW Chemical Sustainability Challenge Award 2012, etc. His research has been highlighted extensively in international media like in Washington Post, Wall Street Journal (WSJ), IEEE Spectrum, etc.