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From nanoelectronics to nanophotonics: Toward integrated nanosystems

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In this talk, the author will discuss innovative concepts and approaches to design, fabricate and exploit novel nanophotonics and nanoelectronics devices/systems for applications in healthcare and energy. Nanowire nanoelectronics field-effect-transistors in 3D arrays can be integrated into 3D macroporous polymeric scaffolds to create synthetic cyborg tissues, in which 3D real-time electric mapping of heart activities with drug responses was demonstrated. Moreover, a bio-inert coating technique was developed to achieve long-term stability of semiconductor nanoelectronics bio-sensors for chronic real-time physiological studies. On the other hand, plasmonic nanoresonators and nanoantennas can control light flows and enhance light-mater interactions at subwavelength scale and thus can potentially be used as nanoscale components in integrated optics systems either for passive optical coupling or for active optical modulation and emission. We investigated a new type of multilayered metal-insulator optical nanocavities that can support multiple localized plasmon resonances with ultra-small mode volumes. The total number of resonance peaks and their resonance wavelengths can be freely and accurately controlled by simple geometric design rules. In addition, we worked to create plasmonic nanoelectrodes that can achieve simultaneously electrical and optical interface with bio-chemical systems. The innovations discussed in this talk could be inspiring for the development toward integrated photonics-electronics nanosystems for applications including solar energy harvesting and conversion systems, lab-on-a-chip biomedical architectures and implantable bio-integrated nanosystems.

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