



Functional materials engineering for electronics and optoelectronics

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Our work is based on materials engineering at the micro/nanoscales and harnessing them for cross-disciplinary applications in electronics, healthcare and environmental monitoring. The work involves three key areas. First is based on deploying thin films of metal oxides to create artificial electronic memories more popularly called memristors. This is based on engineering oxygen vacancy movement via electric fields to create multiple resistance states within a single device.

Second, is the investigation of two-dimensional semiconducting materials, understanding fundamentals, engineer defects and deploy them to create field-effect transistors and emulation of synaptic interfaces. Within this theme, our work has also demonstrated the ability to create semiconductor-free transistors by fabricating extremely small gaps between metal electrodes.

Third is translating these functionalities onto stretchable platforms and the development of wearable sensors for monitoring of UV radiation and obnoxious gases. This is based on the discovery of a unique transfer process using which brittle high-temperature metal oxides can be transferred onto elastomeric platforms such as Polydimethylsiloxane (PDMS). This allows translating the full-suite of properties that metal oxides have on offer into wearable sensors and devices.

In summary, our research encompasses the synthesis and manipulation of a number of material systems, understanding light-matter interactions and exploiting this knowledge for next-generation of devices and micro/nanosystems.