Abstract

If each era is defined by disruptive and influential discoveries and inventions such as fire, wheel and steam engine that enabled quantum leaps in mankind's behavior and lifestyle, our era is inarguably defined by silicon and silicon-based technologies. Indeed, the king of materials has profoundly revolutionized the way we communicate, collect and transfer information, use and preserve natural resources, and interact with our local and global environments. For instance, none of the digital wonders we enjoy today from internet searches to wireless communications would be possible without the mastery of silicon integrated circuits and computer chips. Even after decades of extensive research, silicon is still the modern innovation powerhouse and its terrain is still fertile with a lot to offer and we are perhaps far from unlocking all its secrets. Within this broad context, this lecture will outline strategies to extend the capabilities of silicon-based technologies and discuss physics and engineering concepts to achieve silicon-compatible all-group IV semiconductor platforms for integrated photonics, infrared optoelectronics, biochemical sensing, and quantum communication.