Since the invention of the point contact transistor over 50 years ago, semiconductor technologies have become a ubiquitous mainstay of our Society. Continued advancements in these technologies rely heavily on materials research spanning many areas including polymer and organic materials which play significant roles as sacrificial, passive and active layers in electronic and photonic devices. The research outlined in this talk will identify fundamental materials parameters that will allow for the definition of materials architectures leading to sub-nanometer scale dimensional control of features for future semiconductor fabrication technologies. The understanding of how to control materials architectures at this sub-nanometer level will lead to organic and polymer semiconductor materials technologies enabling the future vision for flexible, printed electronic devices and display technologies.