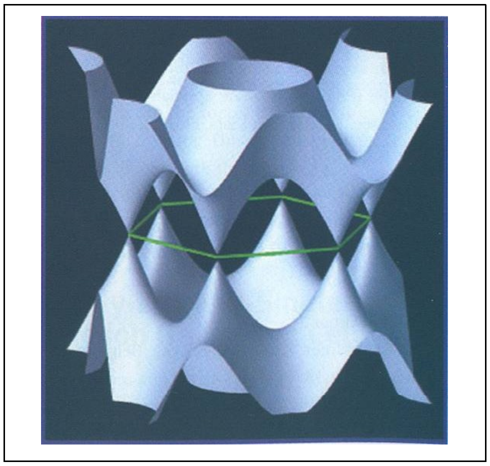
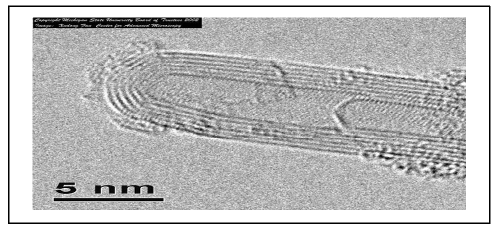
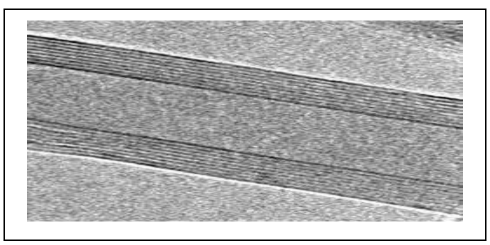
Carbon for electronics

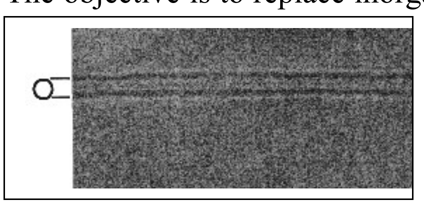
Electronics, as we know is based on silicon, and on metals like copper. One may ask why carbon, and what kind of electronics? The answer lies, partly in the fact that the most common form of carbon, graphite is a semimetal, it's electronic properties lie between a metal and a semiconductor, and nano-scale forms of the material can be made to resemble a metal, such as copper and a semiconductor such a silicon. The materials are based on carbon, and – in contrast to polymers – carbon alone, no weak carbon-hydrogen bonds, the potential sources or concern.



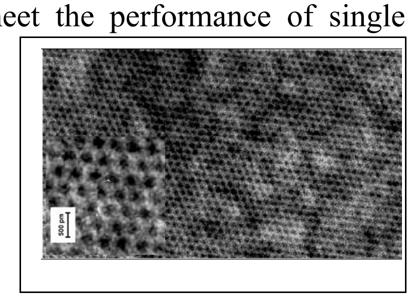




Currently our overwhelming focus of the group is carbon nanotubes, a rolled-up form of graphene. The tube or wire is small, the diameter is smaller than DNA, and it typically longer that 1 micron. It's properties are truly amazing. The carbon bonds are strong, ensuring robustness and environmental resistance. The conductivity and current carrying capacity is large, and the mobility is high.



The objective is to replace inorganic electronic materials, compromising the performance but capitalizing on easy/cheap manufacturing and attributes such as mechanical flexibility. Of course some qualifying statements have to be made: for example we can not meet the performance of single crystal silicon, but can match the performance of amorphous silicon – and in addition, can capitalize on properties such as mechanical flexibility. This then leads to "printed electronics" as the best value proposition for carbon based materials: while the devices based on a random network do not have a play in the silicon – or even I n the post-silicon era, they will have a significant



impact on printed RFID tags, displays, solar cells, OLEDs, charge storage devices and the like.