ONE-DIMENSIONAL WIRES AND THEIR INTERCONNECTIONS

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As electronic devices shrink down to nanometer scale, we face not only processing problems but also conceptual limits in the integration process. Accurate alignment of nano-devices, routing of the interconnecting wires and increasing access time to each transistor are three most frequently asked problems. With these conceptual barriers ahead, it is time to think about alternate devices and their integration schemes. Scientists found interesting transport properties in 1-D systems as early as in 1974. Organic, metal, semiconductor and biological wires have shown metallic or semiconducting properties. These observations have opened ways to make 1-D active devices and functional 1-D systems by interconnecting semiconducting wires with gate oxides and metals to metallic interconnection wires. So far, many different configurations have been proposed to produce switching devices. But all these devices still suffer from poor signal to noise ratio and undesirable characteristic curves because of defects in the 1-D wires. The integration of 1-D active devices is even more difficult than the construction of the devices themselves. The devices are too small to make wire-bondings to their electrodes and the spaces between neighboring devices are too small to route the interconnecting wires around the devices. Among many functional 1-D systems, we chose to study carbon nanotube as a test 1-D system for its well-known geometrical structure, symmetric property, electrical properties and synthesis technology. Recently, it has been shown experimentally that fullerenes, metals or insulators can be inserted into single wall nanotubes, forming a chemically modified carbon nanotubes[1]. These newly developed materials can be used as parts of active electronic devices. We can produce junctions between metal and semiconductor or semiconductor and semiconductor. In this presentation, geometric, electronic and transport properties of several 1-D wires will be given. Lastly, we show our new network logic that integrates these 1-D wires.

[1] J. Lee, H. Kim, S.J. Kahng, G. Kim, Y.W. Son, J. Ihm, H. Katon, Z.W. Wang, T. Okazaki, H. Shinohara, Y. Kuk, Nature **415**, 1005 (2002)

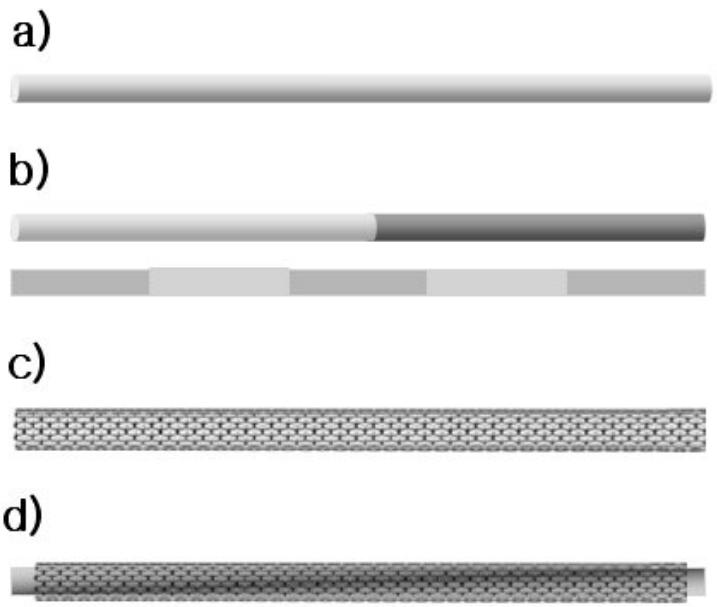

Fig.1 Desirable 1 dimensional wires for integration: a) metallic wire, b) semiconductor-metal or semiconductor-semiconductor junctions, c) protection cage and d) metal or semiconductor wire encapsulated by a cage.