We have developed a novel method of manufacturing and assembling process termed nano-pelleting [1-2], which refers to large-scale handling and long-range order assembly of individual carbon nanotubes (CNTs). The nano-pelleting concept overcomes the limitation of very small-scale order by embedding carbon nanotubes into micro-scale pellets. This technique includes vertically growing single strand CNTs, embedding a CNT into a polymeric pellet, separating a pellet, and transplanting a CNT. The CNTs are grown vertically, both individually and in bunches, on the patterned catalytic metal using a plasma enhanced chemical vapor deposition (PECVD) machine (Figure 1) built by us at MIT. The machine's key feature is the control of the substrate temperature during the growth process. At the bottom of the ceramic heater, three thermocouples are connected to measure the temperature, which is controlled by the heater controller. Plasma is formed between anode and cathode by applying a DC voltage, which then decomposes acetylene into carbon that deposits below the Ni catalyst and leads to the formation of carbon nanotubes. The process sequence to make pellets is the following: coating PMMA on the silicon wafer, exposing the photo-resists using Raith 150 to obtain the desired patterns by varying the aperture size, dose, electric field, developing the photo-resist, depositing Ti/Ni (25nm), and lifting-off the resist to obtain Ni-catalyst nano-dots. Single stranded CNTs are grown in the PECVD machine with optimized process conditions as shown in Figure 2. On these isolated CNTs, SU-8 is spin-coated to form a thickness of 25 micro-meter. This SU-8 layer is exposed to UV light using an appropriate mask and then developed to form nano-pellets. The nano-pellets are released from the silicon substrate by manually breaking them with a spark needle. We are developing an in-plane AFM probe [3] with mechanically assembled CNT tips.

REFERENCES