

## **Tensile test of Carbon Nanotube Using Manipulator in Scanning Electron Microscope**

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### **Abstract**

To be applicable in nano-scale devices such as optical sensor, electronic sensor, gas sensor and etc., The mechanical properties of nano-size materials (nanotube/wire/rod) must be recognized. Especially, mechanical strengths of carbon nanotube (CNT) have rarely understood because of measurement difficulties. Therefore, Tensile test of an individual multi walled carbon nanotube (MWNT) was carried out using force sensor inside scanning electron microscope and then the strength characteristics of MWNT were evaluated. The force sensor was likely formed cantilever and was automatically controlled by nano-manipulator and personal computer. The nano-manipulator permitted the movement defined at a scale of 2 nm along all three axes and operated in a range of X, Y:120mm and Z:150mm, respectively. MWNT were produced by arc-discharge method and specimens for tensile test were selected among the MWNT which has rectilinearity and purity above 40%. The diameter of MWNT was approximately 15nm. The individual MWNT was attached on the rigid support and the tip of force sensor using electron beam and tensile test was performed. Fractured surface of MWNT was also observed by transmission electron microscope (TEM). The fractured area of MWNT was calculated at about  $7.179\text{nm}^2$  from the result of TEM and then the calculated elastic modulus was 213.8GPa from the results of tensile test.