

## **Growth of carbon nanotubes with diameter and density control**

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Controlling the diameter and density of carbon nanotubes (CNTs) has been emerging as a challenge in order to apply field emission devices. Therefore, many research groups have suggested a variety of ways to control the diameter and density.

In this work, we proposed and applied embedded catalyst method instead of conventional laminated catalyst method in order to control the diameter and density of CNTs more precisely and effectively. This method enables not only reducing one process step but also controlling density and diameter of CNTs by adjusting amount of catalyst metal in the sputtering target and adjusting rf power during sputtering process.

The density and diameter of the CNTs could be successfully controlled by the concentration of Fe in the sputter target and the rf power during the sputtering process, respectively. The density of CNTs increased with an increase in the concentration Fe in the sputter target, and the diameter of CNTs was decreased with a decrease in the rf power during the deposition of catalyst-embedded supporting layer. Furthermore, the embedded catalyst system effectively restricted the agglomeration of the catalyst, which leads to the growth of CNTs with a narrow diameter distribution, compared to the laminated catalyst system with a supporting layer.