

Airborne nanowires

Nanowires are very small conducting wires and have the potential to enhance many existing technologies. However, they are difficult to manufacture in large scale. Aerotaxy offers a scalable manufacturing method which is based on creating nanowires from particles suspended in a gas. This thesis presents a study of aerotaxy grown GaAs nanowires from Ga particles.

Electronic devices play a major role in our everyday life. All kinds of computers, mobile phones included, are based on a device called the transistor. A series of these devices acts as the "brain" of the machine, allowing it to perform complicated tasks, and are therefore a vital component for most technologies. A larger amount of transistors allows for faster calculations, small transistors are therefore preferred, but difficult to fabricate. By replacing some parts of the device with nanowires, which are very small conducting wires usually a few μm (10^{-6}m) in length, we can achieve small transistors with better properties. Such nanowires can be used in a range of other technologies, such as solar panels or LEDs. One of the main challenges which prevents them from entering the market in large scale is their expensive and time-consuming manufacturing.

Generally, nanowires are created from a plane, called substrate, where a small liquid particle, or seed particle, is placed. By introducing specific gases a small wire is formed, or grown, beneath the particle. However this method is difficult to scale up and often requires an expensive substrate. In this thesis we make use of a different method, called Aerotaxy, which is based on small liquid particles which are suspended in a gas and transported through a hot reactor where other gases are introduced. A small nanowire will be created from the liquid particle. This process is displayed in figure 1.

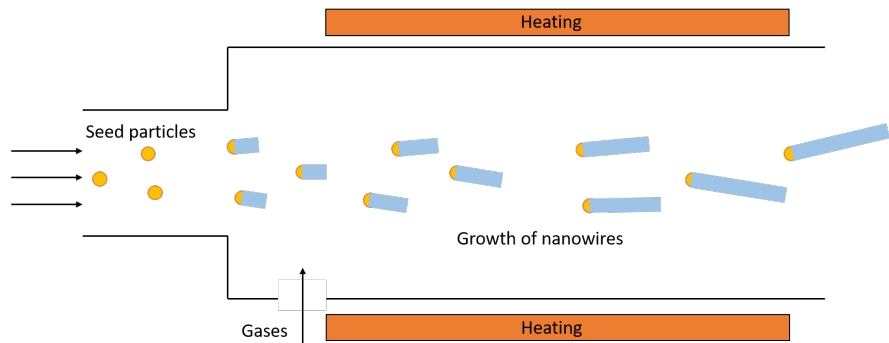


Figure 1: Schematic of nanowire growth through aerotaxy.

Usually, gold is used as the material for the liquid particle but some of the gold from the particle may be transported into the nanowire during the process, therefore harming some of its properties. In this thesis we employ gallium as the material for the seed particle, which differently from gold, actually contributes towards the growth of the nanowire, which is composed of gallium and arsenic.

The novel material for the seed particle is found to create good quality nanowires therefore proving that this type of growth is possible. Several factors, such as temperature, seed particle diameter or gas flows, are found to affect the shape and length of the nanowires. This work presents an in depth exploration of GaAs nanowires grown from Ga seed particle through Aerotaxy.

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