SELECTIVE GROWTH OF CARBON NANOTUBES BY MICROWAVE IRRADIATION

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Microwave-assisted synthesis is of increasing interest. Besides the fact, that the reaction kinetics can be positively influenced by the use of microwave irradiation, advanced reaction conditions can be applied.[1,2] Moreover, the absorption of the microwave radiation depends on the material properties, thus resulting in a selective heating mechanism.[3-5] A detailed investigation of the selective heating of surface bound iron nanoparticles provided first experimental evidence for this effect by utilizing a self-assembled monolayer of *n*-octadecyltrichlorosilane (OTS), which acts as a sensitive indicator for locally elevated temperatures.

This selective heating process was furthermore used to grow carbon nanofibers and nanotubes on nickel catalyst. By using ethanol as a carbon source, provided by a liquid reservoir which is located beneath the sample, a flux of highly flammable and explosive feeding gas mixtures was avoided. As a result carbon nanotubes (CNTs) were synthesized in short times scales of a few minutes only. The synthetic approach can be applied also to obtain patterned carbon nanotube films which indicate a homogeneous growth of the tubes (Figure 1).

The investigation of the reaction conditions by analysis of temperature and pressure curves permitted [6] the determination of the reaction conditions. These investigations led to a significant improvement of the developed method and resulted into the controllable synthesis of defined carbon nanotubes and carbon nanofibers systems. This microwave-assisted method provides advantages over conventionally used methods, i.e., the reduced reaction time, the lower overall exposure temperature of the substrates and its potential for the integration of one-dimensional carbon material into predefined device frameworks consisting of different materials.

References:

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Figures:

Figure 1. SEM images of patterned growth of carbon nanofibers from iron catalyst (top row) and carbon nanotubes from nickel catalyst (bottom row)