The Emissivity of Surfaces Coated with Carbon Nanotubes and Safety Considerations Regarding their Handling

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Multi-walled carbon nanotubes (MWCNT), directly grown on substrates, show promising technical properties due to their very high emittance. However, emissivity data published so far often did not provide angularly resolved information. Here, several MWCNT coated substrates from different suppliers were characterized at the emissivity measurement setups of PTB under air and vacuum. The measurements were performed spectrally and angularly resolved over a wavelength range from 4 µm to 100 µm, an angular range from 10° to 70°, and a temperature range from 25 °C to 250 °C. While planning these measurements and appropriate handling procedures, the currently unsatisfying situation regarding material safety data sheets of MWCNT coatings became apparent. Consequently, safety studies were performed with two experienced partner institutes in the field of work safety and exposure to nano-sized particles. The emission of and inhalation exposure to MWCNTs from coated surfaces were studied by air samples. The influence of work processes onto the coated samples was simulated in a test chamber. The taken air samples were analyzed under a scanning electron microscope (SEM). It was shown that in case of careless handling an emission of the investigated MWCNT into air is possible. Consequently, workplace measurements under realistic conditions were performed. Stationary particle sampling and sampling at the person were conducted during the practical handling of substrates coated with MWCNTs. The samples were analyzed by a modified SEM analysis procedure to be able to compare the results with a suggested occupational exposure limit value (OELV) of 10 000 fibres per cubic meter (m^{-3}). The results show no emission of the investigated MWCNT above the limit of quantification; consequently, it could be assumed that no relevant exposure has taken place. The personal sampling results supported this finding. Since unintended mechanical damage of a MWCNT layer during the assembly may occur, risk management measures were implemented in the laboratory.