NANEX WP2 – Exposure Scenarios Summary

Please note this ES was not developed as part of a full risk assessment process, and may not necessarily describe exposure conditions for which there are no risks to human health and the environment

Standard Exposure Scenario Format 1: For Uses Of Substances By Workers

Title:	Synthesis of CNT by CVD	**Date:**	12/07/2010
SubstanceType	CNT	**Entered By:**	LEIA

Internal reference ID:	CNT 3

List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC) if relevant:

List of names of contributing exposure scenarios and corresponding PROCs/PCs

CES 1: Synthesis of CNT by Chemical Vapour Deposition (CVD) (considering the whole cycle, including the removal of the substrate)

CES 1: Name of contributing exposure

Synthesis of CNT by Chemical Vapour Deposition (CVD) (considering the whole cycle, including the removal of the substrate)

Further specification

Forests of vertically-aligned CNTs are grown by atmospheric pressure CVD, using a horizontal quartz tube furnace. Growth occurs on a silicon substrate coated with a Fe/Al2O3 film. After the growth period, furnace is purged with He. Next, sample is pushed out of the tube. Finally, forest of CNT is removed from the substrate by gentle mechanical action using a razor blade.
Steps of the whole cycle (monitored): furnace heating, CNT growth, furnace cool-down, opening of furnace, removal of the substrate, and mechanical removal of CNTs from the silicon substrate

Product characteristics

CNT with an average outer diameter of 8nm.
Typically, the CNT forest grows to approximately 1.5 mm (3 mg/cm2) in 20min

Amounts used

Frequency and duration of use/exposure

The time of the whole cycle monitored is 1.5 h.

Human factors not influenced by risk management

Other given operational conditions affecting workers exposure

Scenario performed in a university research lab.

Technical conditions and measures at process level (source) to prevent release

Technical conditions and measures to control dispersion from source towards the worker

The exhaust from the furnace passes through a bubbler containing paraffin oil, and then into the building ventilation system.
For this study, the removal of forest CNT from the substrate (using a razor blade) is made without local exhaust ventilation.

Organisational measures to prevent /limit releases, dispersion and exposure

Conditions and measures related to personal protection, hygiene and health evaluation

Additional good practice advice (for environment) beyond the REACH CSA

Exposure Estimation

Techniques to characterize particles: FMPS (TSI model 3091); CPC (TSI CPS 3007); a thermophoretic precipitator (TP, Fraunhofer Institute of Toxicology, Germany) and electrostatic precipitator (ESP, courtesy of Dr. A. Miller, Spokane Laboratory, NIOSH, VW); asbestos sampling cassette. Collected samples were analysed by SEM, TEM and elemental analysis by EDS.

EXPOSURE DATA:
- No increase of the total particle concentration (10nm to < 1 micrometer) during each cycle of the process. Total particle number concentration 4000-7000 #/cm3 for all the processes (FMPS and CPC 3007) (quite similar to background and typical indoor concentrations).
- No increase of number of particles in any particular size range during the different cycles of the process. Two peaks at aprox 10 and 100 nm, similarly in background and in all cycles of the process (FMPS).
- Collected samples:
TEM images showed particles aprox 10 and 100 nm, commonly seen in outdoor and indoor background samples that may be originated from multiple sources (combustion engines).
Larger carbonaceous particles up to 1 µm were also seen, especially during the opening of the furnace. Particle agglomerates of similar morphology and made primarily of carbon (EDS) were found on the backup bubbler oil.
No evidence of individual nanoscale fibers or bundles of CNTs was found.

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References

Ref Title: Particle exposure levels during CVD growth and subsequent handling of vertically-aligned carbon nanotube films
Author: Bello D, Hart AJ, Ahn K, Hallock M, Yamamoto N, Garcia EJ, Ellenbecker MJ, Wardle BL
Journal: Carbon 46 (2008) 974-981
Ref Year: 2008