definition of limit values for low, moderate and high dustiness. The SEM-aided morphological analysis allowed us to rank the materials for the propensity to emit individual fibres and their grade of agglomeration. We also measured the diameter and length distributions to identify potential rigid fibres and those matching the WHO-criteria for hazardous fibres. These results are the basis of our proposed new grouping strategy for control banding, which classifies HARM using a risk matrix that considers both intrinsic material and process-related properties such as bio-durability, toxicity as well as dustiness, grade of agglomeration and presence of hazardous WHO-fibres.

1601g OCCUPATIONAL EXPOSURE TO CARBON NANOTUBES: THE STATE OF KNOWLEDGE

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Introduction In an emerging field of nanotechnologies, assessment of exposure is an integral component of occupational and environmental epidemiology, risk assessment and management, as well as regulatory actions. This review focuses occupational exposure to carbon nanotubes (CNT).
Methods PubMed and Scopus databases were searched for period 2000–2017 using all keywords combinations based on the following structure: 'assessment' and 'exposure' and 'carbon nanotube'. The words 'assessment' and 'exposure' were alternatively replaced by 'measurement' and by 'human' and 'occupational', respectively. The word 'carbon nanotube' was alternatively replaced by 'single-walled carbon nanotube', 'double-walled carbon nanotube', 'multi-walled carbon nanotube', and their abbreviations. Only field-studies conducted in occupational settings were included. The quality of the exposure measurement protocol and results reporting were reviewed. The results were compared with the current NIOSH recommended exposure limit (REL) of 1 $\mu g/m^3$ respirable elemental carbon (EC) mass-concentration as an 8 hour time-weighted average.
Result Twenty-five studies conducted in R and D laboratories, small-scale pilot-production facilities, and, more rarely, large-scale primary or secondary manufacturer/user facilities in the USA (eleven), the Republic of Korea (four), Japan (four), Russia (one) and Europe (four) were reviewed. Open handling of CNT powder during the sieving, mechanical work-up, packaging, and clean-up work-tasks was classified at highest likelihood of exposure. Fourteen most recent studies measured EC concentration, although using different methods and aerosol fractions. All but one studies observed EC values exceeding the REL. The quantification of CNT agglomerates and/or CNT-contained particles lacks methodological standardisation and precluded any comparison of results.
Discussion Currently available occupational-exposure data are limited, because production and use of CNT are relatively recent and workforce sizes remain small. Due to high variability of methods and instruments used for exposure sampling and analysis and of criteria used for interpreting their results, results are difficult to compare. Further effort of methodological standardisation is warranted.

1601h CHALLENGING ISSUES IN CARBON NANOTUBE OCCUPATIONAL RISK ASSESSMENT AND MANAGEMENT STRATEGIES

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Introduction High aspect ratio nanoparticles (HARNs) represent a growth area in nanotechnology. Best known of all HARNs are carbon nanotubes (CNTs). These nanomaterials have found applications in several production fields with subsequent potential for occupational exposure during industrial manufacture, use and disposal. Concerns regarding possible adverse health effects on workers who are routinely exposed to CNTs have been motivated by their resemblance to asbestos fibres, as well as by the International Agency for Research on Cancer classification of one type of multi-walled, CNTs-7, as 'possibly carcinogenic to humans'. Therefore, aim of this work is to point out critical topics that should be addressed in industrial hygiene contexts for a suitable CNT risk assessment and precautionary management.
Methods Available literature was analysed to extrapolate priorities of research concerning toxicological issues, risk assessment and management strategies for CNT exposed workers.
Results Toxicological *in vitro* and *in vivo* research may be helpful in identifying and characterising CNT hazards, particularly in defining what are the properties that may dictate fibre pathogenicity including carcinogenicity, i.e. width, length, biopersistence. Additionally, environmental monitoring strategies should be developed to assess not only airborne CNT concentrations, but also other metric parameters, i.e. fibre number and surface area, which may better represent the effective dose for adverse health effects. In this scenario, innovative field-portable, near real-time instruments, and personal samplers can meaningfully provide more timely and accurate aerosol characterisation.
Discussion The extrapolation of definite evidence for CNT risk characterisation seem a challenging issue due to great heterogeneity of these materials. Suitable toxicity models able to predict fiber-type pathogenic effects according to specific physico-chemical characteristics and doses of exposure should be pursued for a suitable risk assessment process. These may be important also for the definition of appropriate occupational exposure limits to manage the exposure and protect workers' health.

Neurotoxicology and Psychophysiology

1713 ADVERSE NEUROLOGIC HEALTH EFFECTS OF OCCUPATIONAL SOLVENT EXPOSURE– FROM RECOGNITION TO PREVENTION

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Aim of the special session The typical adverse neurological effect of long-term occupational solvent exposure is called