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DETECTION OF CARBON NANOTUBES AND CARBON NANODISCS ON WORKPLACE SURFACES IN A SMALL-SCALE PRODUCER

Maria Hedmer1, Linus Ludvigsson2, Christina Isaxon3, Patrik Nilsson3, Vidar Skaug4, Mats Bohgård5, Joakim H. Pagels5, Maria E. Messing2, and Håkan Tinnerberg1

1Occupational and Environmental Medicine, Lund University, Sweden; 2Solid State Physics, Lund University, Sweden; 3Ergonomics and Aerosol Technology, Lund University, Sweden; 4National Institute of Occupational Health, Oslo, Norway

Background: The industrial use of carbon-based engineered nanomaterials, e.g., carbon nanotubes (CNTs), carbon nanofibers, carbon black, graphene nanoplatelets, carbon nanodiscs, and carbon nanocones, is increasing globally. The health effects of many nanomaterials are today not yet fully characterised, and to handle engineered nanomaterials a high degree of control measures and personal protective equipment are required. The release of airborne nano-objects, and their aggregates and agglomerates (NOAA) during production and handling can contaminate workplace surfaces with dust, which can be resuspended resulting in secondary inhalation exposures and dermal exposures. This study aimed to survey the presence of CNTs, carbon nanodiscs, and carbon nanocones as surface contamination at a small-scale producer to assess the potential for secondary inhalation exposure due to resuspension and dermal exposure.

Methods: Eighteen different surfaces (work areas, floors, handles, other surfaces) at a small-scale producer were sampled with an adhesive tape sampling method. The chosen sampling surfaces were all associated with the production and handling of CNT powder. The tape samples were analysed with scanning electron microscopy to detect the carbon-based NOAA. Air sampling with a personal impactor was also performed on a worker producing CNTs the same day as the tape samples were collected.

Results: CNTs were detected in 50% of the collected tape samples and carbon nanodiscs in 16% (Fig. 1). No carbon nanocones were detected on the samples surfaces. CNTs and carbon nanodiscs were identified at all locations in the workplace, thus increasing the risk for secondary inhalation and dermal exposure of the workers. Both airborne CNTs and carbon nanodiscs were detected in the personal impactor samples.

Conclusions: Tape sampling is a functional method for detecting surface contamination of carbon-based NOAA and for exposure control during production at potentially any workplace that produces or handles such engineered nanomaterials. With the tape method it is possible to monitor if a risk of secondary inhalation exposure or potential dermal exposure exists through resuspension of dust deposited on workplace surfaces. With the air sampling we could confirm that carbon nanodiscs were resuspended into the air at the workplace, as these were not produced nor handled during the measurement. CNTs also were detected in the air samples, but the CNTs can be derived from either resuspension or from the work tasks with CNTs that were performed during the air sampling. Tape sampling is a complementary method to air sampling and together these two methods provide a better view of the hygienic situation in workplaces where NOAA can be released into work environments.

Fig. 1. SEM images of surface contamination of carbon-based nanomaterials from a tape sample collected nearby a saw in the production laboratory. The white bar in the images corresponds to 10 µm. a) Carbon nanodiscs. b) CNTs.