Title *

In vitro mechanistic toxicology assessment of the inhalation hazard and genotoxic potential of few-layer graphene

Abstract *

Few-layer graphene (FLG), bearing three or more graphene sheets, is a revolutionary nanomaterial with highly tuneable properties giving rise to novel applications in *e.g.*hydrogen storage and touch-screen technology. Human exposure to FLG is inevitable due to the constant production rate, particularly within occupational environments. Thus, understanding of the potential human health (inhalation) hazard posed by FLG is imperative. This study sought to understand the mechanistic toxicology of different surface charged (neutral, amine and carboxyl) 724 m^2/g FLG. The biological impact of these different FLG samples in terms of their ability to cause reactive oxygen species (ROS) (DCFH-DA assay) a (pro)-inflammatory response (interleukin(IL)-8 and IL-6) and genotoxicity (cytokinesis block micronucleus assay) in an epithelial cell-line (16HBE14o$^-$) was assessed over a 24hr period at 0-0.1 mg/mL.

At sub-lethal concentrations significant (p <0.05) genotoxicity was observed in cells treated with neutral- and amine-FLG at 0.01 and 0.05mg/mL, displaying significant 3.5 and 2.5 fold increases over control at 0.1mg/mL. Further analysis observed a significant (p <0.05) elevation in both IL-8 and ROS for all surface charged FLG samples, displaying a hazard ranking of neutral-FLG >amine-FLG >carboxyl-FLG. These results indicate that the ability for the FLG materials to cause ROS can directly influence the (pro)-inflammatory mediator response at FLG-concentrations > 0.01 mg/mL. Despite this, in summary, neutral-FLG overall poses the greater inhalation hazard via sustained ROS generation increasing the (pro)-inflammatory response potentially contributing to the observed genotoxic response over an acute exposure period.

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