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The interaction of graphene-related materials with in vitro lung cell types

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Graphene and Graphene related materials are the latest and one of the most popular discoveries in the field of nanotechnology, exhibiting exceptional material properties, based on its structure. These advantageous properties are structural strength, robustness yet high flexibility, high electrical and thermal conductance makes it attractive for many applications. With the expanding global production and huge commercial interest in the rapidly advancing and increasing field of nanotechnology, occupational, consumer but also environmental human exposure to Graphene based NM will increase. Considering that inhalation of nanomaterials is the main route of unintended exposure, the lung is most at risk to interact with inhaled nanomaterials, as nanomaterials are able to cross the alveolar lung barrier and enter the human circulation to a small extent. Since the current literature on graphene related materials is limited and reveals contradictory results with regards to the different graphene types, the aim of this thesis is to evaluate the cellular interactions of diverse types of Graphene and Graphene related materials, with cell types of the lung alveolar barrier, focusing mainly on phagocytic macrophages. Our first study examined the acute effects of several graphene related materials on THP-1 macrophages, in order to define a structure activity relationship for graphene related materials. With a toxicological assessment we aimed to identify which GRM property and concentration can cause oxidative stress, reduce cell viability, and promote inflammatory reactions in THP-1 macrophages. Further, we aimed to explore the cellular effects of two types of graphene nanomaterials on two types of macrophages, human THP-1 macrophages, and human monocyte derived macrophages. With a transcriptomic analysis of gene expression, we were studying the impacts of graphene materials on molecular level to get insights into possible regulated adverse signalling pathways.

Jury:

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