Title *

Fate and impacts of brake wear nanoparticles on airway epithelial cells

Abstract *

Brake wear particles have been rarely studied so far. This heterogeneous mixture including a nanosized fraction with a majority of metallic compounds, can represent an important source of non-exhaust traffic related particles (55%).

Our purpose was to characterize brake wear particles, select and assess its nanosize fraction fate and effect on bronchial epithelial cells, in comparison with iron oxide engineered nanoparticles. Calu-3 cells were used because they provide an efficient barrier due to the formation of a tight polarized epithelium, producing mucus when grown on Transwells.

Brake wear dusts recovered from brake test bench or entire vehicles were characterized by thermogravimetric analysis and X-fluorescence showing their low carbonaceous and high metal content, and by microscopy revealing a large size distribution below 10 µm. Fractionation was performed to recover the nanosize fraction (hydrodynamic diameter based around 150 nm) which represent 26wt%.

After 24 hrs of exposure, brake wear and Fe_2O_3 nanoparticles induced a slight increase of epithelial permeability at the highest dose (100 µg/cm^2) measured by transepithelial electric resistance and Lucifer Yellow permeability assay, with no evident modification of ZO-1 immunostaining, suggesting limited effect on epithelial barrier integrity. Treated cultures exhibited a higher expression of mucins as well as a rearrangement of the actin cytoskeleton. Fate of nanoparticles was assessed using spICPMS allowing to study translocation of both soluble and particulate fractions through epithelial barrier, first results showed a low translocation.

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