Nanoparticles from non-exhaust emissions: lung deposition and potential health impacts

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1. What are non-exhaust emissions?

Fig. 1 Tyre wear, brake wear and road dust are non-exhaust road emissions. In contrast, exhaust road emissions are caused by tailpipe emissions.

2. More non-exhaust than exhaust emissions

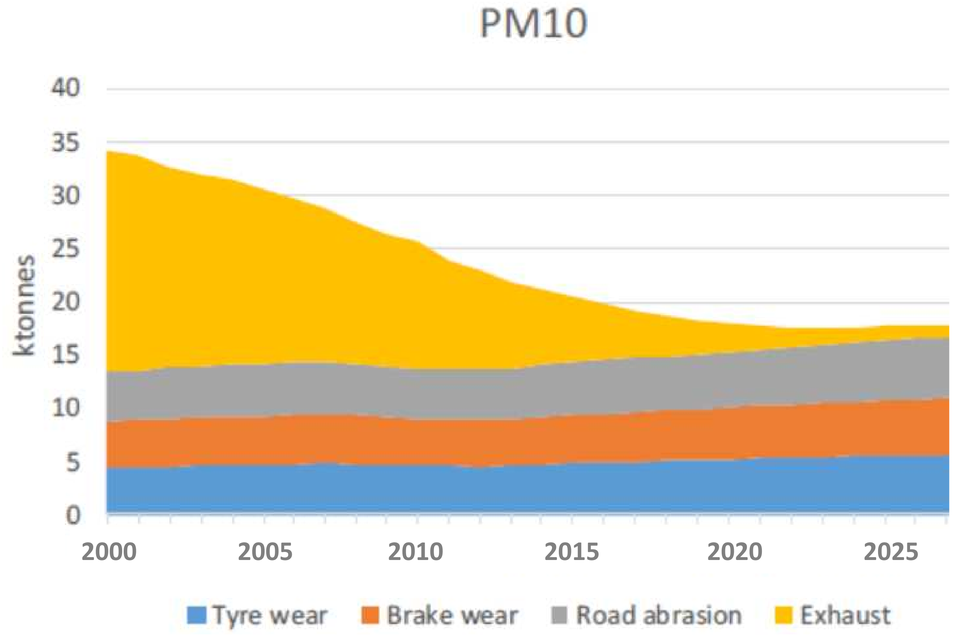


Fig. 2 There is more particulate matter (PM) caused by non-exhaust than exhaust emissions on UK roads.[1] Non-exhaust emissions are expected to become more important due to increasing traffic volumes[2] and a trend towards heavier vehicles (SUV's and electric cars).[3-6]

3. Motivation

- Particulate matter (PM) kills more people than road traffic crashes, malaria and AIDS combined. PM is the leading cause of pollution-related mortality. Approximately 3.5 million annual premature deaths are linked to PM (40 % of all pollution-related deaths).[11,12]
- Non-exhaust emissions are not regulated although they are a major source of urban PM.

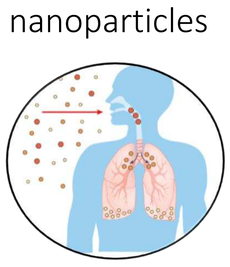
4. Health effects of non-exhaust emissions are poorly understood

- For decades, research focused on exhaust emissions.
- Non-exhaust and exhaust emissions are present simultaneously: correlation vs causation.
- Epidemiological studies have identified health problems caused by road PM: but which emission source?
- The spectrum of non-exhaust emissions ranges from rubber particles in the millimetre range[7], to metal-containing nanoparticles from brake pads[8-10]. Which health effect is caused by which component of the sample? When is a sample representative?

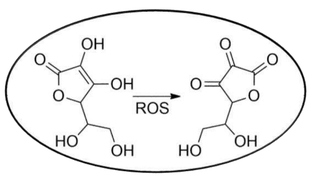
5. Research objectives and methodology

Assessing the health implications of non-exhaust nanoparticles:

- Collecting tyre and brake nanoparticles (dynamometer, impactor).
- Modelling lung deposition



- Measuring oxidative potential (quantifying glutathione /ascorbic acid in a surrogate lung fluid using liquid chromatography).



- Testing the effect on aggregation of amyloid beta, which has been linked to Alzheimer's disease.

6. Research hypothesis: Alzheimer's disease and nanoparticles?

Hypothesis:

"Non-exhaust nanoparticles enter the human brain via nose-to-brain delivery. Once in the brain, they accelerate the development of Alzheimer's disease by promoting the aggregation of amyloid beta (Aβ)."

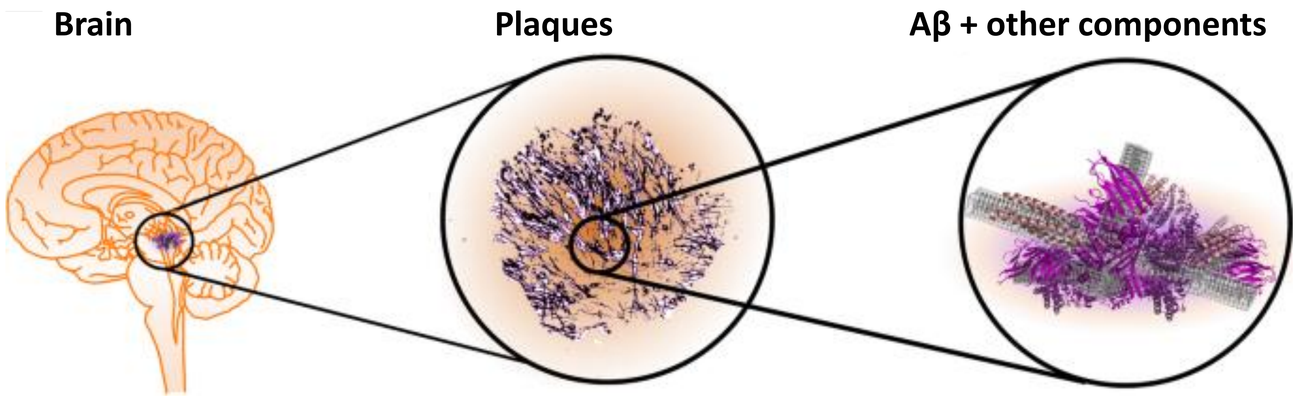


Fig. 3 The aggregation of amyloid beta (Aβ) causes the formation of plaques and the development of Alzheimer's disease.[14]

References

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