

Multi-Techniques for the Isolation and Characterisation of Tyre and Road-Wear Particles from Urban Dust



National Environmental Science Program

Tyre and Road-Wear Particles (TRWP)

Every time vehicles apply brakes, accelerate, or turn, Tyre and road-wear particles (TRWP) are released from tyres onto roads. These tiny particles are now recognised as one of the largest sources of microplastic pollution in urban areas. Unlike conventional plastic fragments, TRWP are complex materials made up of rubber, mineral fillers, and road dust. As a result of their hybrid composition, these particles are difficult to detect, measure, and regulate.

Under-Studied Critical Knowledge Gaps in TRWP Research

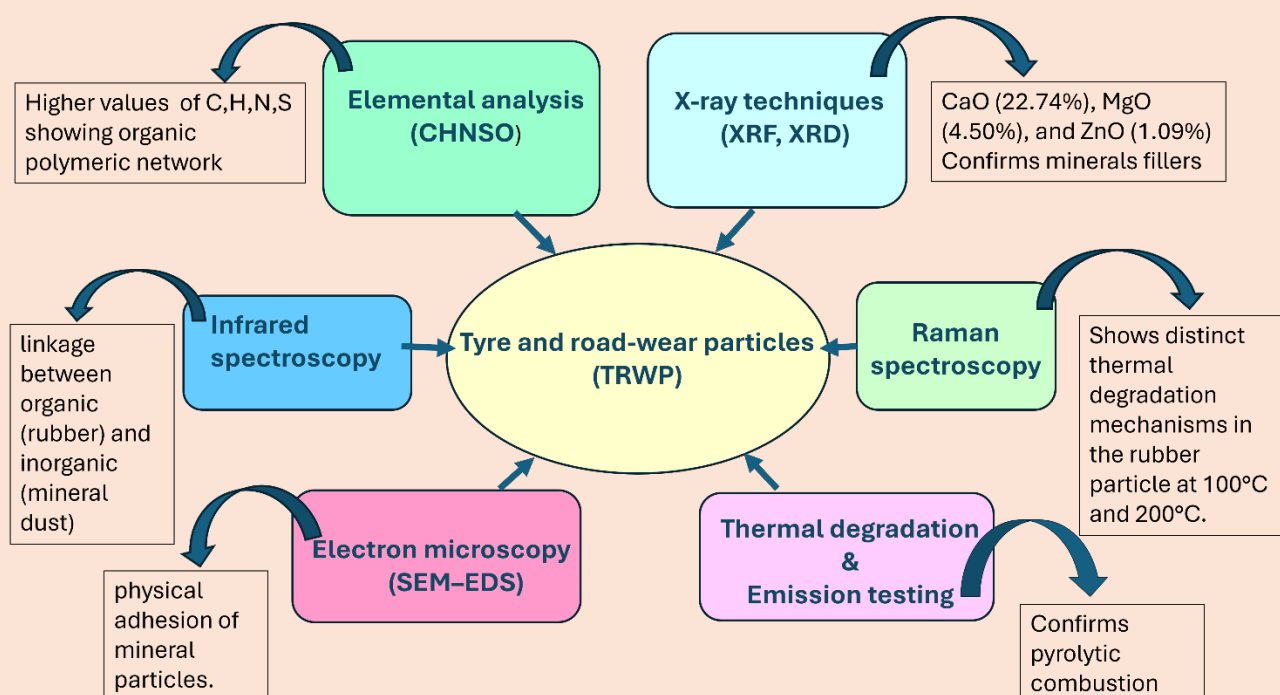
- Lack of standardised sampling and separation protocols
- Limited quantitative mass-based data in environmental matrices
- Insufficient understanding of surface oxidation and mineralisation processes that govern TRWP ageing

Need for This Study

Understanding how these particles behave in the environment is essential for:

- Accurate microplastic monitoring
- Urban pollution management
- Non-exhaust vehicle emission assessment
- Evidence-based policy and regulation

Project Description: Road dust samples were collected from urban areas in Sydney. Researchers developed a standardised, safe and reproducible separation method using a sodium iodide (NaI) density solution to isolate tyre particles from mineral dust with 70–90% recovery efficiency. For precise identification of tyre particles in urban dust, a comprehensive testing regime was carried out.

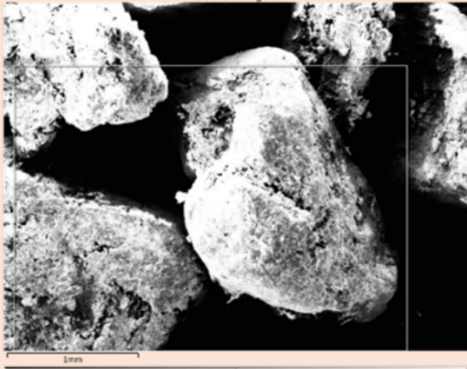


Rumana Hossain and Veena Sahajwalla

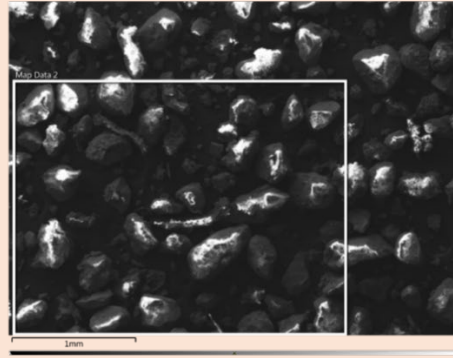
The SCaW Hub is funded by the Australian Government under the National Environmental Science Program.

To view the full report, visit the project page for Impact Priority 2
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SEM Images



The TRWP exhibited rough, irregularly fractured surfaces with visible microcracks and pores, indicative of mechanical wear and oxidative embrittlement.



The collected road dust before separation revealed a more complex microstructure: rubber fragments coated or embedded with fine mineral particles

Key Findings

TRWP are Hybrid Particles

Tyre particles are not simple plastics. They contain:

- Vulcanised rubber
- Calcium carbonate (CaCO_3) fillers
- Zinc oxide (ZnO) additives
- Carbon black
- Mineral dust and road salts

These particles become coated with silicates and iron oxides from the road surface, forming durable carbon–mineral composites.

Environmental Ageing Increases Persistence

Exposure to sunlight, friction, and heat causes:

- Surface oxidation
- Structural disorder
- Formation of mineral coatings

These changes enhance environmental persistence and complicate identification in microplastic surveys.

Even Low-Temperature Emissions Matter

Innovatively evaluated VOC emissions under controlled thermal transition between 100°C (surface ageing & moisture release) and 200°C (active rubber degradation) provides important insights into:

- Non-exhaust vehicle emissions
- Urban heat exposure
- Shredding and recycling processes for tyre materials
- Safe thermal processing of tyre materials

Significance of the Study

The study provides a scientific foundation for improved monitoring, regulation, and management of tyre-derived pollution by developing a reproducible and multi-instrumental workflow. This research will:

- Improve accuracy of tyre microplastic detection
- Reduce risk of misclassification in monitoring programs
- Support non-exhaust emission policy development
- Strengthen environmental risk assessment frameworks
- Contribute to national microplastic research

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