



TriDurLE

**National Center for Transportation
Infrastructure Durability & Life-Extension**

UTC Project Information – National UTC TriDurLE	
Project Title	Nanomodified Cementitious Composites Incorporating Waste Polymer Microfibers for Durable and Environmentally Friendly Infrastructure
University	Washington State University
Principal Investigator	Xianming Shi, PhD, PE, F. ASCE
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Funding Source(s) and Amount Provided (by each agency or organization)	\$ 90,428 from UTC National Center of TriDurLE \$ 90,428 in-kind match from WSDOT
Total Project Cost	\$ 180,856
Agency ID or Contract Number	
Start and End Dates	May 2022 to September 2023
Brief Description of Research Project	Used face masks resulting from the COVID-19 pandemic are forming a new waste stream that poses a considerable environmental risk to the ecosystem if not properly disposed of. Typically, single-use medical masks are made of polypropylene (PP) or polyester fabric, and they are extremely difficult to be naturally degraded. Another similar waste stream is induced by the vast quantity of waste textiles (e.g., waste clothes), which also mainly contain polypropylene or polyester products. Based on the published research of PP fiber-reinforced cementitious composites, we propose to convert the waste medical masks/textiles into cost-effective PP microfibers that can replace the more expensive commercial PP microfibers used by the concrete industry. To this end, this proposed project will build on the team's previous research experience, which relates to fiber-reinforced cementitious composites and nanotechnology for concrete, and then develop nanomodified microfiber-reinforced cementitious composites (nm-FRCCs) featuring comparable engineering performance with cementitious composites reinforced by commercial polymer microfibers. At the first stage of this work, the laboratory study aims to: 1) Convert waste masks/textiles to microfibers that feature comparable diameter with commercial

	<p>concrete industry-adoptive PP fibers, and 2) Fabricate nmFRCCs that feature promising mechanical properties and durability performance. Specifically, nanomaterials (graphene oxide and nanoclay) will be introduced to modify the waste mask/textile fibers (WM/TFs) and thus enhance the interfacial transition zone (ITZ) between the fibers and the cementitious matrix. To further investigate the influence of nanomaterials on the engineering performance of nmFRCCs, the scanning electron microscopy (SEM), Energy-dispersive X-ray spectroscopy (EDX), Thermogravimetry analysis (TGA), Differential Scanning Calorimetry (DSC), Fourier transform infrared spectroscopy (FTIR), Electron probe microanalysis (EPMA), and X-ray diffraction analysis (XRD) will be employed to illustrate the hydration mechanisms (especially the interfacial hydration process) of nmFRCCs and to shed light on how the constituent materials affect the mechanical strengths and durability performance of the nmFRCCs.</p>
<p>Describe Implementation of Research Outcomes (or why not implemented)</p> <p>Place Any Photos Here</p>	<p>The deliverables will include periodical teleconferences with team members or stakeholders on a need basis, and a final project report that documents the study background, approach, results, discussion, conclusions, and recommendations. The PI will develop one webinar to communicate the value and findings of this research to potential stakeholders. This project will produce at least one peer-reviewed paper for presentation at the Transportation Research Board (TRB) annual meeting and one publication in a peer-reviewed journal (e.g., Cement and Concrete Composites, ASCE, or ACI journals). One patent application may be filed out of this project.</p>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>This work is expected to produce substantial benefits for DOTs and other concrete infrastructure owners and stakeholders. The nmFRCCs will feature superior mechanical properties and durability performance that benefits the transportation infrastructure.</p>
<p>Web links</p> <ul style="list-style-type: none"> • Reports • Project website 	