



Nanoscale Organisation
and Dynamics Group

Development of High Performance Nanocomposite Adhesive Materials

Name: A/Prof. Sarah Zhang

WSU Research Theme Champion (Environment & Sustainability)

Discipline Leader (Civil & Environmental Engineering)

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Abstract

Adhesive bonding technology has become popular in recent years due to its capability of bonding various types of materials such as metals, ceramics, polymers and composites. Epoxy adhesives are the most extensively used structural adhesives for bonding different components in aerospace and automotive industries due to their excellent adhesion and corrosion resistance. However, the high crosslinking density makes the epoxy resin a brittle material, having a fracture energy about two orders of magnitude lower than engineering thermoplastics and three orders of magnitude lower than metals, diminishing the strength of epoxy adhesive joints and, therefore limits their applicability. This research developed a high shear strength epoxy-based nanocomposite adhesive materials and investigated the bonded joint performance. CNTs were functionalized using an ultrasonicated-ozonolysis process to enhance the uniform and stable dispersion of CNT, and 3-roll mill was employed to achieve the uniform distribution of CNT in the epoxy matrix. Two different triblock copolymers named as SBM and MAM were used as toughening agents to improve the shear strength of the nanocomposite adhesive material. Single lap shear tests were performed on the aluminum adhesively bonded joints using pure and modified epoxy adhesives to determine the shear strength of the adhesive. The effect of different weight fractions of untreated CNTs, functionalized CNTs, and the hybrid effect of CNTs and triblock copolymer addition on the shear strength of the adhesive joints was studied. It was found that the use of functionalization and 3-roll mill methods are effective to achieve stable and even dispersion of the CNTs and the shear strength was improved by 26% (23.6 MPa) compared to that of pure epoxy. The hybrid effect of functionalized CNTs and SBM showed the maximum shear strength of 44.7 MPa, with an increase of 137% compared to that of the pure epoxy demonstrating the effectiveness of the triblock copolymer addition in improving the shear strength.

Profile

Associate Professor Zhang is the Western Sydney University Research Theme Champion on Environment and Sustainability, Discipline Leader for Civil and Environmental Engineering, and the director of Grand Challenges Scholars Program. She joined Western Sydney University in Jan. 2019. Before that she worked in the University of New South Wales for 15 years staying 11 years in UNSW, Canberra since 2007 as a Lecturer, Senior Lecturer and then Associate Professor. She received her PhD on Structural Engineering from the University of Hong Kong in 2001.

She has strong interest in Environment and Sustainability, and has strong expertise on advanced composite materials including construction and building materials in Civil Engineering and composites in Mechanical and Aeronautical Engineering. She has been working on novel and green cement, green cementitious

composites by using industry wastes and high-performance fibre reinforced cementitious composite aiming to achieve durable, resilient and sustainable infrastructures. She has a strong expertise on numerical modelling and analysis. In addition to using the experimental technique she also uses advanced numerical modelling technique to calibrate the mechanical behaviour of materials and model the structural behaviour including under extreme loading conditions such as impact/blast/fatigue/fire loadings. Since 1998, she has published over 240 peer-reviewed scholarly research papers including more than 100 research papers in top international journals in her research areas. She was awarded research grant of around \$9 million from various schemes including Australian Research Council (ARC), Australia Defence and government.

She was awarded the Spitfire Defence Memorial Fellowship in 2011 and received by the Australian Governor in General for her research on impact-resistance construction material. She has served as local organisation committee and international technical committee member or advisory board member for over 15 international conferences. She has been a frequent reviewer for up to 20 leading International journals.

Staff and students at all levels are welcome to attend.

Venue and Time:

This talk will be held at 2 pm Monday 13 July via **Zoom:**

<https://uws.zoom.us/j/92296578795?pwd=NjZSWXYxUG5hYk9Gb0VsQWoxQzhxQT09>

Meeting ID: 922 9657 8795

Password: 739747

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