Dr. Wei Tan

Reader in Mechanics of Materials, Queen Mary University of London
wei.tan@qmul.ac.uk | www.sems.qmul.ac.uk/staff/wei.tan | London, UK

Research Group | Google Scholar | GitHub | LinkedIn

Summary

Dr Wei Tan is a Reader (UK senior rank, equivalent to Associate Professor) at Queen Mary University of London whose research advances **sustainable materials technology through the development of circular and multifunctional composite material systems** for aerospace, energy, and biomedical applications. His work is organised around three integrated research themes: (1) **Circular and multifunctional composite materials**, encompassing recyclable and self-healing polymer matrices and coating, bio-based fibre reinforced composite systems, and multifunctional structural materials; (2) **Materials-informed mechanics and multiscale modelling**, developing predictive frameworks that link microstructural damage, durability, and processing to structural-scale performance and lifetime; and (3) **Data-driven materials design for sustainability-by-design**, integrating physics-based modelling with AI to accelerate materials discovery and optimise mechanical performance, manufacturability, life cycle analysis, and environmental impact under sparse and noisy data conditions. Dr Tan has published over **50 peer-reviewed journal articles** in leading materials and mechanics journals (∼**3000 citations, H-index 25**, Google Scholar). He has secured approximately **£2 million** in competitive research funding as Principal Investigator, including support from the **ERC Starting Grant / UKRI Frontier Research**, **EPSRC New Investigator Award**, and the **Royal Society**. His research excellence has been recognised through awards such as the **2024 ESCM Young Researcher Award**, the **Cambridge CAPE BlueSky Research Award**, and the **Royal Aeronautical Society Bronze Award**, alongside more than **25 invited and plenary lectures** at major international venues.

Education

Queen's University Belfast (QUB) — Belfast, UK
PhD in Composite Materials — *2012 – 2016*

Central South University (CSU) — Changsha, China
Master in Mechanical Engineering (transferred to PhD directly) — *2011 – 2012*

Central South University — Changsha, China
Double BEng in Mechanical Engineering and Physics (Top 1%) — *2007 – 2011*

Research Experience

Reader (2024) / Senior Lecturer (2022) / Lecturer 2020 – Present
Queen Mary University of London (QMUL) *London, UK*

- Development of circular and multifunctional composite materials, including recyclable polymer matrices, sustainable fibres, and functional coatings, designed for durability, repairability, and extended service life.
- Mechanics-based characterisation and multiscale modelling of sustainable composite systems, linking microstructural damage mechanisms to structural performance to enable resilient design and lifetime extension.
- Data-driven design and optimisation for sustainability-by-design, integrating physics-based modelling with AI to optimise composite materials for mechanical performance, manufacturability, and life-cycle CO_2 and energy impact.

Research Associate (Advisor: Prof. Norman Fleck, FRS, FREng) 2016 – 2019
University of Cambridge *Cambridge, UK*

- Developed a scalable manufacturing route for direct-spun carbon nanotube (CNT) mat polymer composites, enabling lightweight and material-efficient multifunctional materials.
- Performed in-situ multi-physics characterisation (SEM, DIC, X-ray CT) to link mechanical, electrical, and thermal behaviour with microstructure, supporting durability and multifunctional performance.
- Established micromechanical models for CNT mat–polymer composites to guide material architecture design for efficient load transfer and functional integration.
- Developed CNT–polyaniline structural supercapacitors, integrating energy storage and load-bearing functionality to reduce material redundancy and support sustainable lightweight systems (in collaboration with Prof. Michael De Volder).

Visiting Researcher (Supervisor: Prof. Javier Llorca, FEMS) 2016
IMDEA Materials Institute *Madrid, Spain*

- Characterised microscale fibre–matrix interfacial behaviour and developed multiscale models to enable durable, damage-tolerant composite materials with extended service life and reduced replacement demand.

PhD Researcher (Supervisor: Prof. Brian Falzon, FRAeS) 2012 – 2016
Queen's University Belfast *Belfast, UK*

- Manufactured and characterised recyclable carbon fibre–thermoplastic (PEKK) composites, targeting improved damage tolerance and end-of-life recyclability.
- Performed virtual testing and design of composite aerostructures under impact and crush loading to minimise material usage and reduce the need for physical prototyping.
- Developed high-fidelity computational models capturing nonlinear behaviour of fibre-reinforced composites to enable predictive design for durability and lifetime extension.

Grants from Research Councils

Principal Investigator Feb. 2016 – Present

- LSIMPACT: Life-like Resilient Materials for Mitigating Liquid-Solid Impact Damage, **ERC Starting Grant/UKRI Frontier Research**, £1.3m, EP/Y037103/1, Aug. 2024-Aug. 2029, EU/UK.
  This project develops **self-healing and recyclable polymer materials** inspired by biological resilience to mitigate impact-induced damage, enabling extended service life, reduced maintenance, and lower embodied CO_2 in energy and transport applications.
- CELLCOMP: Data-driven Mechanistic Modelling of Scalable Cellular Composites for Crash Energy Absorption, **EPSRC New Investigator Award**, Grant NO. EP/V049259/1, 2022-2025, £392k, UK.
  This project combines mechanics-based modelling and AI to design **lightweight, material-efficient cellular composites**, enabling improved crash performance with reduced material use and embodied CO_2 for sustainable transport applications.
- From Lab to Field: Developing Resilient Coating Materials for Rain Erosion Protection in Wind Turbine Applications, funded by Henry Royce Institute/EPSRC, **Royce Industrial Collaboration Programme**, Grant NO. EP/X527257/1, 2025-2026, £100K, UK.
  The project is collaborating with Energy Technology Centre Ltd and the UK National X-ray CT Facility to validate material performance under industry-relevant service conditions, bridging laboratory-scale development with field testing.
- Decoding the Material Degradation Mechanisms Under High-velocity Liquid-solid Impact Loadings, **Royal Society Research Grant**, Grant NO. RGS/R1/231417, 2023-2025, £70k, UK.
  This project elucidates impact-driven degradation mechanisms in engineering materials to enable **durable and erosion-resistant surfaces**, supporting lifetime extension, reduced maintenance, and lower material and energy demand in energy and infrastructure systems.
- Structural supercapacitors using hybrid carbon fibre/carbon nanotube composites, funded by University of Cambridge, **CAPE Blue Sky Research Award**, Grant NO. NMZD/256, 2017-2018, £20k, UK.
  This project explored **multifunctional composite materials** that integrate structural load-bearing and energy storage, enabling material efficiency, system level lightweighting, and reduced component redundancy for sustainable energy and transport applications.

Co-Investigator April 2020 – Present

- Thermal-mechanical modelling of graphene-related composite materials, Graphene Flagship Core Project 3, funded by EU Commission - Horizon 2020, No. 881603, 2020-2023, £376K, EU

Industry funded projects

Principal Investigator Feb. 2022 – Present

- Nippon Sheet Glass (NSG) Group, Development of new composite package materials for sheet glass, £28k, June-August 2022. The project was highly successful, and we

jointly filed a **patent** (No. 2314036.1).

- Reading Scientific Services Ltd (RSSL), Research project on characterisation of the fracture toughness of new recyclable polymer package materials, £18k, Feb-March 2023

Awards, Distinctions and Honours

- **ERC Starting Grant (UKRI Frontier Research)**, 2024
- **EPSRC New Investigator Award**, 2022
- **ESCM Young Researcher Award**, European Society for Composite Materials (ESCM), 2024.
- **Royal Aeronautical Society Bronze Award**, Written Paper Prize, 2018.
- **QMUL Research Excellence Award**, 2023.
- **QMUL Education and Student Experience Award**, 2022.
- Ranked among the **World's Top 2% Scientists** (Materials), 2023–2025, Elsevier/Stanford Data Repository.
- Recipient, **Cambridge Engineering SEM Photo Prize**, 2017.
- Second Prize, Sir Bernard Crossland Poster Competition, UK, 2013.
- First Prize, Mechanical Innovation Design Competition, Hunan Province, China, 2010.

Teaching

Computational Engineering (80+ MSc and MEng students) 2025 – Present

- Introduces finite element analysis and numerical or AI-driven optimisation for lightweight, efficient design in aerospace and biomedical applications.

Computational and Mathematical Modelling 1 (500+ Year-1 UGs) 2021 – Present

- Integrates mathematics, statics (engineering mechanics), and Python programming for active, open-ended learning.

Failure of Materials (150+ Year-3 UGs) 2020 – 2025

- Teaches fracture, fatigue, creep, and plasticity in materials engineering.

Final year group project, Lecturer, 20+ 3rd-year UG students Sep. 2023 – Present

- Design and modelling of composite materials for wind turbine applications

Ceramics, Lecturer, 120+ 4th-year UG students Oct. 2020 – Present

- To allow students to understand and analyse the mechanical properties of ceramics materials.

Materials, Tutor, Two 2nd-year students at Cambridge Sep. 2016 –Dec. 2017

Supervision

Primary supervisor (now 3 PDRAs, 6 PhD students) Jan. 2020 – Present

- **Postdoc researcher**: Dr. Devender Kumar, 2025-present, QMUL, Project: Experimental Mechanics of Resilient Materials for mitigating Liquid-solid Impact.
- **Postdoc researcher**: Dr. Yang Liu, 2024-present, QMUL, Project: Computational Modelling of Resilient Materials for mitigating Liquid-solid Impact.
- **Postdoc researcher**: Dr. Hongye Guo, 2024-present, QMUL, Project: Manufacturing New Resilient Materials for mitigating Liquid-solid Impact.
- **Postdoc researcher**: Dr. Jinlong Fu, 2023-2025, QMUL, Project: Data-driven Mechanistic Modelling of Scalable Cellular Composites for Crash Energy Absorption. (Now an Alexdener Hombert Fellow at Leibniz University Hannover.
- **Postdoc researcher**: Dr. Siamak Khosroshahi, 2022-2023, QMUL, Project: Data-driven Mechanistic Modelling of Scalable Cellular Composites for Crash Energy Absorption. (Now a senior CAE engineer at Subsea 7)
- **PhD student**: Yu Yuan, 2020-2024, QMUL, Project: The Finite Integration Method Algorithm and its Applications in Solid Mechanics. (Graduated)
- **PhD student**: Hirak Kansara, 2021-present, QMUL, Project: Developing novel cellular composites for Crash Energy Absorption using Data-driven methods. (PhD defended, pass with minor corrections)
- **PhD student**: Wenqi Wang, 2021-present, QMUL, Project: Scalable cellular composites for crashing energy absorption. (PhD defended, pass with minor corrections)
- **PhD student**: Emilio Felipe Gomez, 2020-present, QMUL, Project: Developing crashworthy and thermally conductive graphene related composite materials for electrical car battery assembly.
- **PhD student**: Jie Yang, 2022-present, QMUL, Project: Multiphysics Modelling and Experimental Investigation for Developing Resilient Electrodes.
- **PhD student**: Afni Restasari, 2022-present, QMUL, Project: Developing self-healing elastomer coatings for wind turbine blades.
- **PhD student**: Luke Webb, 2024-present, QMUL, Project: Modelling liquid-solid impact behaviour of materials
- **PhD student**: Haoming Sun, 2025-present, QMUL, Project: Development of smart AI-powered composite materials with self-sensing and self-repairing functions
- Visiting PhD student: Rui Mao, 2024-present, QMUL, project: Structural battery composites.
- Visiting PhD student: Samina Ishaq, 2024-present, QMUL, project: Hybrid composite materials.
- Visiting PhD student: Zhengqiang Cheng, 2021-2022, QMUL, project: Low-velocity impact damage tolerance of carbon fibre composites.(Now Assistant professor in Southwest Jiaotong University)
- MRes student: Marco Antonio Gallegos Gardea, 2024-present, QMUL, Project: Testing and modelling of porous materials and composites
- MSc student: Luke J. Webb, 2023-present, QMUL, project: Modelling the liquid-solid impact damage of materials.

- MSc student: Syju Pappy Alexander, 2022-2023, Lightweight composite materials for hydrogen storage tank
- MSc student: Kang Xu, 2022-2023, Smooth Particles Hydrodynamics for liquid-solid impact modelling
- MSc student: Kit Au-Yeung, 2021-2022, QMUL, project: Phase-Field Fracture Modelling of Anisotropic Composite Laminates. (Now working in Subsea7 as a research engineer)
- MEng students: Gary Koh, Merrin Rose Varghese, Hirak Kansara, John Luk, 2020-2021, QMUL, Project: 3D Printed Cellular Composites for Impact Mitigation or Crash Energy Absorption.
- MEng students: Abdulaziz Nasiruddin, Evangelos Koliolios, Daniel Mills, Wei-kong Mao, 2020-2021, QMUL, Project: The crashworthiness of carbon nanotube composite electrodes for energy-storage applications.

Co-supervisor Jan. 2021 – Present

- PhD student: Qichen Zhou, 2021-Present, QMUL, Project:silk-based fibre-reinforced composites. (Primary supervisor: Dr. Emiliano Bilotti)

Outreach and Engagement Activities

Advanced Materials Show, National Exhibition Centre (Birmingham) May 2024

- Represented QMUL at a major trade fair, presenting "Creating Lighter, More Durable Advanced Materials for Transport Applications". Showcased research on lightweight composites for sustainable transport systems and engaged with industry partners to foster collaborations.

New Scientist Live, ExCeL Exhibition Centre (London) Oct 2024

- Participated under the **Henry Royce Institute's** "Discovery Materials" theme. Demonstrated shape-morphing materials (e.g., light-responsive liquid crystal elastomers) to engage public audiences and promote materials science education.

Festival of Communities, Queen Mary University of London June 2022 & 2023

- Showcased research on "Lightweight Materials for Sustainable Transportation". Demonstrated natural fibre composites and 3D-printed structures.
- Organised the children's hands-on competition "Make Your Crash Helmet for Eggs", where participants designed lightweight impact-protection devices using recycled materials.

Editorial and Reviewing Roles

- **Associate Editor**, *Frontiers in Mechanical Engineering* (Solid Mechanics), 2021–Present.
- **Managing Guest Editor**, *Engineering with Computers*, special issue for UKACM2025 conference, 2025–Present.
- **Guest Editor**, *Applied Mathematical Modelling*, SI "Advances in AI-Enhanced Computational Mechanics: Bridging Data-Driven and Physics-Aware Paradigms", 2025–Present.
- **Guest Editor**, *Advances in Mechanical Engineering*, special issue in "Mechanics of Rotating and Cyclic Structures", 2025–Present.

- **Topic Editor**, *Polymers*, 2021–Present.
- Grant reviewer for **ERC Consolidator Grants**, **EPSRC Standard Grants**, and the **Polish National Science Centre**.
- Reviewer for over 20 journals including *Advanced Functional Materials*, *Journal of Materials Science*, *Composites Science and Technology*, *Composite Structures*, *Journal of Mechanics and Physics of Solids*, and *Thin-Walled Structures*.

Professional Memberships and Service

- **Fellow**, Institute of Materials, Minerals and Mining (IoM3), 2025–Present.
- **Executive Board Member**, UK Association for Computational Mechanics (UKACM), 2021–Present.
- Member, **Royal Aeronautical Society** (RAeS), since 2012.
- Member, **European Mechanics Society**, since 2018.
- **Fellow**, Higher Education Academy (FHEA), since 2022.
- President, Student Branch of AIAA Belfast, 2013–2015.

Leadership and Institutional Roles

- **Chair**, SEMS Computing Committee, Queen Mary University of London, 2023–Present.
- **Outreach Academic Lead**, School of Engineering and Materials Science, QMUL, 2022–2024.
- Founder and Director of the **TanLab**, a research group (10+ members) focused on the design of sustainable and circular material systems, integrating materials development, mechanics-informed modelling, and AI-enabled optimisation.

Conference and Symposium Activities

- **Conference Joint Chair** for UK Association for Computational Mechanics 2025 (**UKACM2025**), co-organised with Prof. Emilio Martínez-Pañeda (Oxford), hosted at QMUL, 150 delegates from 14 countries and 64 Universities, April 2025
- WCCM ECCOMAS Mini-symposium organiser for "MS205 – Computational Material Design via Mechanics or Machine Learning Approaches", with Prof. Burigede Liu (Cambridge), Dr. Jinlong Fu and Dr. Yang Liu, July 2026
- ECCM Special Session organiser for "Session 15: AI- and Mechanics-Based Optimisation and Digital Twins for Composite Materials", with Prof. Carlos Gonzalez (IMDEA Material), June 2026
- COMPLAS2025 Mini-symposium organiser for "Mechanics or Machine Learning Methods for Computational Material Design", with Prof. Burigede Liu (Cambridge), September 2025
- Session Chair in ICTAM2024, SM07, Multi-component, composite, hierachical materials, South Korea, September 2024

- Session Chair in UKACM2024, Durham University, April 2024
- Session Chairs in ICCM2023, Belfast, August 2023
- Session Chair in UKACM2022, University of Nottingham, April 2022

Publications

(12 as first-author and 21 as corresponding-author*; ∼3000 citations; **H-index 25**)

(1) Sustainable Composites– Manufacture, Characterisation, and Validation

1. Q. Zhou, **W. Tan**, E. Bilotti*, et al., Hierarchical materials from fused silk (Under revision, A very novel paper on the bio–sourced, recyclable, and biodegradable silk composites. We report a simple and rapid thermo–mechanical process to fuse silk fibres into high perfomance and multifunctional solid materials. We have filed a Patent and submitted it to **Nature Sustainability**. My contribution: as the 2nd supervisor of Zhou, contributed to the initial idea generation, mechanical testing, modelling and analysis)
2. R. Mao, S. Feng, Z. Lei*, R. Bai, **W. Tan***, Mechano-electrochemical analysis of lithiation-induced deformation of composite electrodes using carbon fibre as current collector, Composites Science and Technology (2025) 111251. doi:10.1016/j.compscitech.2025.111251
3. H. Kansara, M. Liu*, Y. He, **W. Tan***, Inverse design and additive manufacturing of shape-morphing structures based on functionally graded composites, Journal of the Mechanics and Physics of Solids (2023) 105382
(**Q1, IF: 5.3, citations: 17, Top journal in Solid Mechanics**, Traditionally, the development of shape–morphing Kirigami structures relied on inefficient trial–and–error forward approaches, often leading to excessive material use and energy–intensive prototyping. To overcome this challenge, we introduced a new **inverse design** framework that leverages nonlinear beam equations and functionally graded composites. This approach not only enables precise control over bending behaviour and shape–changing performance but also minimises waste, reduces the need for repeated manufacturing cycles) doi:10.1016/j.jmps.2023.105382
4. H. Sun, D. Xiang, T. Qiu, L. Liu, M. Wang*, C. Zhao, B. Wang, H. Li, Y. Wu, **W. Tan***, Damage self-sensing behavior of basalt fiber/polymer composites modified via electrophoretic deposition, Available at SSRN 5457441.
URL https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5457441
5. **W. Tan**, J. C. Stallard, C. Jo, M. F. De Volder, N. A. Fleck*, The mechanical and electrochemical properties of polyaniline-coated carbon nanotube mat, Journal of Energy Storage 41 (2021) 102757 (Q1, IF: 9.4, citations: 9). doi:10.1016/j.est.2021.102757
6. **W. Tan**, J. C. Stallard, F. R. Smail, A. M. Boies, N. A. Fleck*, The mechanical and electrical properties of direct-spun carbon nanotube mat-epoxy composites, Carbon 150 (2019) 489–504 (Q1, IF: 10.9, citations: 41). doi:10.1016/j.carbon.2019.04.118

7. **W. Tan***, F. Naya, L. Yang, T. Chang, B. Falzon*, L. Zhan*, J. Molina-Aldareguía, C. González, J. Llorca*, The role of interfacial properties on the intralaminar and interlaminar damage behaviour of unidirectional composite laminates: Experimental characterization and multiscale modelling, Composites Part B: Engineering 138 (2018) 206–221 (**Q1, IF: 13.1, citations: 126**.) doi:10.1016/j.compositesb.2017.11.043
8. R. Wang, B. Niu, **W. Tan***, A novel multistable honeycomb structure with tailored variable-length functions, Engineering Structures (2025) 119354 (Q1, IF: 5.6) doi:10.1016/j.engstruct.2024.119354
9. E. Koliolios, D. G. Mills, J. J. Busfield, **W. Tan***, The nail penetration behaviour of carbon nanotube composite electrodes for energy storage, Frontiers in Materials (2021) 429 (Q2, IF: 3.2) doi:10.3389/fmats.2021.741541
10. J.-J. Mao*, S. Wang, **W. Tan***, M. Liu*, Modular multistable metamaterials with reprogrammable mechanical properties, Engineering Structures 272 (2022) 114976 (Q1, IF: 5.5, citations: 15). doi:10.1016/j.engstruct.2022.114976
11. X. Zhang, **W. Tan**, T. Carey, B. Wen, D. He, A. Arbab, A. Groombridge, F. Smail, J. de La Verpilliere, C. Yao, et al., Enhanced composite thermal conductivity by percolated networks of in-situ confined-grown carbon nanotubes, Nano Research (2023) 1–9 (Q1, IF: 8.9)
doi:10.1007/s12274-023-6209-6
12. D. Xiang, T. Shui, H. Qiao, **W. Tan**, E. Harkin-Jones, J. Zhang, P. Ji, P. Wang, B. Wang, C. Zhao, et al., Enhanced interfacial interaction, mechanical properties and thermal stability of basalt fiber/epoxy composites with multi-scale reinforcements, Composite Interfaces (2023) 1–23 (Q2, IF: 2.6, citations: 3) doi:10.1080/09276440.2023.2220500
13. H. Sun, D. Xiang, J. Zhang, **W. Tan**, E. Harkin-Jones, J. Wang, M. Wang, B. Wang, C. Zhao, H. Li, et al., Electrical, mechanical and damage self-sensing properties of basalt fiber reinforced polymer composites modified by electrophoretic deposition, Progress in Natural Science: Materials International (2023) 593–600 (Q1, IF: 4.7)
doi:10.1016/j.pnsc.2023.11.003
14. X. Wang, P. Li, D. Xiang, B. Wang, Z. Zhang, J. Zhang, C. Zhao, H. Li, **W. Tan**, J. Wang, et al., Influence of high-temperature, high-pressure, and acidic conditions on the structure and properties of high-performance organic fibers, Materials Testing 64 (5) (2022) 623–635 (Q2, IF: 1.59, citations: 1) . doi:10.1515/mt-2021-2099
15. J. Ge, **W. Tan**, S. Ahmad, B. G. Falzon, G. Catalanotti, C. Higgins, Y. Jin, D. Sun, Temperature-dependent cutting physics in orthogonal cutting of carbon fibre reinforced thermoplastic (cfrtp) composite, Composites Part A: Applied Science and Manufacturing 176 (2024) 107820 (Q1, IF: 8.7). doi:10.1016/j.compositesa.2023.107820
16. T. Gspann, A. Kaniyoor, **W. Tan**, P. Kloza, J. Bulmer, J. Mizen, G. Divitini, J. Terrones, D. Tune, J. Cook, et al., Catalyst-mediated enhancement of carbon nanotube textiles by laser irradiation: Nanoparticle sweating and bundle alignmen, Catalyst 2021 (11) (2021) 368. doi:10.3390/catal11030368

17. X. Zhang, **W. Tan**, F. Smail, M. De Volder, N. Fleck, A. Boies, High-fidelity characterization on anisotropic thermal conductivity of carbon nanotube sheets and on their effects of thermal enhancement of nanocomposites, Nanotechnology 29 (36) (2018) 365708 (Q1, IF: 3.9, citations: 14). doi:10.1088/1361-6528/aacd7b
18. J. Stallard, **W. Tan**, F. Smail, T. Gspann, A. Boies, N. Fleck, The mechanical and electrical properties of direct-spun carbon nanotube mats, Extreme Mechanics Letters 21 (2018) 65–75 (Q1, IF: 4.7, citations: 74). doi:10.1016/j.eml.2018.03.003
19. T. Chang, L. Zhan, **W. Tan**, S. Li, Effect of autoclave pressure on interfacial properties at micro-and macro-level in polymer-matrix composite laminates, Fibers and Polymers 18 (8) (2017) 1614–1622. doi:10.1007/s12221-017-7384-4
20. H. Liu, B. G. Falzon, **W. Tan**, Experimental and numerical studies on the impact response of damage-tolerant hybrid unidirectional/woven carbon-fibre reinforced composite laminates, Composites Part B: Engineering 136 (2018) 101–118 (Q1, IF: 13.2, citations: 215) . doi:10.1016/j.compositesb.2017.10.016

(2) Mechanics-Enabled Modelling and Design of Sustainable Composite Materials

21. Y. Liu, B. Xia, Z. Li, H. Ren, J. Du, **W. Tan***, Co-design of structures via generalized evolution, Computer Methods in Applied Mechanics and Engineering 450 (2026) 118584, (**Q1, IF: 6.9, NO.1 journal in Computational Mechanics**. The framework enables simultaneous shape and topology optimisation by evolving two surrogate hypersurfaces through tangential (shape) and orthogonal (topology) evolution. This unified approach expands the design space and enables engineers and researchers to explore truly co–designed structural solutions). doi:10.1016/j.cma.2025.118584
22. J. Yang, **W. Tan***, Fully coupled multiphysics modelling of fracture behaviour in silicon particles during lithiation–delithiation using the phase-field method, Engineering with Computers 42 (1) (2026) 7. doi:10.1007/s00366-025-02233-w
23. Y. Liu, **W. Tan***, A differential equation-driven update strategy for density-based topology optimization: implementation with matlab codes, Engineering with Computers (2026). doi:10.1007/s00366-025-02237-6
24. **W. Tan**, E. Martínez-Pañeda*, Phase field predictions of microscopic fracture and r-curve behaviour of fibre-reinforced composites, Composites Science and Technology (2021) 108539
    (**Q1, IF: 9.1, citations: 100**, Understanding microstructural effects on composite fractures is challenging due to the high computational cost. This study presents a **novel multiscale phase field fracture** model to predict microscale crack behaviour and explores the effect of porosity on the fracture toughness. The findings offer insights for designing damage–tolerant materials efficiently). doi:10.1016/j.compscitech.2020.108539
25. L. Webb, C. Kadapa, **W. Tan***, A numerical framework for high-velocity liquid-solid impact: Multiphase flow and fluid-structure interactions, Available at SSRN 5092850 (**Liquid–solid impact modelling**, a novel contribution to model the liquid–solid impact behaviour).
    URL https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5092850

26. K. Au-Yeung, A. Quintanas-Corominas, E. Martínez-Pañeda, **W. Tan***, Hygroscopic phase field fracture modelling of composite materials, Engineering with Computers (2023) 1–18
(**Q1, IF: 8.7, citations: 7**, This paper presents a new **multi–physics phase field modelling** to capture the influence of **moisture and temperature** on composite materials). doi:10.1007/s00366-023-01820-z
27. Z.-Q. Cheng, H. Liu, **W. Tan***, Advanced computational modelling of composite materials, Engineering Fracture Mechanics (2024) 110120 (Q1, IF: 4.7) doi:10.1016/j.engfracmech.2024.110120
28. Z.-Q. Cheng, J.-J. Xiong, **W. Tan***, Fatigue crack growth and life prediction of 7075-t62 aluminium-alloy thin-sheets with low-velocity impact damage under block spectrum loading, International Journal of Fatigue (2021) 106618 (Q1, IF: 6.0, citations: 13)
doi:10.1016/j.ijfatigue.2021.106618
29. **W. Tan***, B. Liu, A physically-based constitutive model for the shear-dominated response and strain rate effect of carbon fibre reinforced composites, Composites Part B: Engineering (2020) 108032 (**Q1, IF: 13.1, citations: 11**. Inspired by crystal plasticity, we develop a **micro–mechanical** model capturing matrix shearing, fibre rotation, and **strain rate effects**, validated against diverse loading scenarios). doi:10.1016/j.compositesb.2020.108032
30. **W. Tan***, B. G. Falzon, A crystal plasticity phenomenological model to capture the non-linear shear response of carbon fibre reinforced composites, International Journal of Lightweight Materials and Manufacture 4 (1) (2020) 99–109 (Q1, IF: 2.2, citations: 8). doi:10.1016/j.ijlmm.2020.06.004
31. R. Jiang, L. Yang, H. Liu, **W. Tan***, X. Sun, H. Cheng, W. Mao, A multiscale methodology quantifying the sintering temperature-dependent mechanical properties of oxide matrix composites, Journal of the American Ceramic Society 101 (7) (2018) 3168–3180 (Q1, IF: 3.9, citations: 16). doi:10.1111/jace.15473
32. **W. Tan**, B. G. Falzon*, Modelling the crush behaviour of thermoplastic composites, Composites Science and Technology 134 (2016) 57–71 (**Q1, IF: 9.1, citations: 122)**. doi:10.1016/j.compscitech.2016.07.015
33. **W. Tan**, B. G. Falzon*, Modelling the nonlinear behaviour and fracture process of as4/pekk thermoplastic composite under shear loading, Composites Science and Technology 126 (2016) 60–77 (**Q1, IF: 9.1, citations: 103)**. doi:10.1016/j.compscitech.2016.02.008
34. **W. Tan**, B. G. Falzon, M. Price, H. Liu, The role of material characterisation in the crush modelling of thermoplastic composite structures, Composite Structures 153 (2016) 914–927 (Q1, IF: 6.3, citations: 44). doi:10.1016/j.compstruct.2016.07.011
35. **W. Tan**, B. G. Falzon, M. Price, Predicting the crushing behaviour of composite material using high-fidelity finite element modelling, International journal of crashworthiness 20 (1) (2015) 60–77 (Q2, IF:1.47, citations: 53). doi:10.1080/13588265.2014.972122
36. **W. Tan**, B. G. Falzon*, L. N. Chiu, M. Price, Predicting low velocity impact damage and compression-after-impact (cai) behaviour of composite laminates,

Composites Part A: Applied Science and Manufacturing 71 (2015) 212–226 (**Q1, IF: 8.7, citations: 526**. Modelling the dynamic impact damage tolerance and residual compression–after–impact strength of composites was highly challenging due to the inherent heterogeneity. This study presented a **continuum damage mechanics** model by integrating the underlying physics of fibre breakage, matrix cracking, and delamination. The model and associated open–source code have been used by many researchers and industrial partners). doi:10.1016/j.compositesa.2015.01.025

37. Z.-Q. Cheng, J. Xia, H. Liu, Z.-W. Zhu, **W. Tan**, Compressive failure mechanisms of fibre metal laminates with 2/1 and 3/2 configurations after low-velocity impact, Thin-Walled Structures 211 (2025) 113112 . doi:10.1016/j.tws.2025.113112
38. B. S. Aragh, **W. Tan**, E. B. Farahani, M. Al-Greer, D. Hughes, Porosity-dependent stability analysis of bio-inspired cellular nanocomposite shells, International Journal of Mechanical Sciences 263 (2024) 108763 (Q1, IF: 7.3). doi:10.1016/j.ijmecsci.2023.108763
39. T. Chang, L. Zhan, **W. Tan***, S. Li, Optimization of curing process for polymer-matrix composites based on orthogonal experimental method, Fibers and Polymers 18 (1) (2017) 148–154. doi:10.1007/s12221-017-6606-0
40. T. Chang, L. Zhan, **W. Tan**, S. Li, Void content and interfacial properties of composite laminates under different autoclave cure pressure, Composite Interfaces 24 (5) (2017) 529–540. doi:10.1080/09276440.2016.1237113
41. Z.-Q. Cheng, **W. Tan**, J.-J. Xiong, E.-M. He, T.-H. Xiong, Y.-P. Wang, Modelling fatigue behaviours and lifetimes of novel glare laminates under random loading spectrum, Composite Structures 311 (2023) 116799 (Q1, IF: 6.3, citations: 3). doi:10.1016/j.compstruct.2023.116799
42. Z.-Q. Cheng, **W. Tan**, J.-J. Xiong, Modelling pre-fatigue, low-velocity impact and post-impact fatigue behaviours of composite helicopter tail structures under multipoint coordinated loading spectrum, Thin-Walled Structures 176 (2022) 109349 (Q1, IF: 6.4, citations: 4). doi:10.1016/j.tws.2022.109349
43. H. Liu, B. G. Falzon, S. Li, **W. Tan**, J. Liu, H. Chai, B. R. Blackman, J. P. Dear, Compressive failure of woven fabric reinforced thermoplastic composites with an open-hole: an experimental and numerical study, Composite Structures 213 (2019) 108–117 (Q1, IF: 6.3, citations: 40) . doi:10.1016/j.compstruct.2019.01.070
44. X. Li, D. Ma, H. Liu, **W. Tan**, X. Gong, C. Zhang, Y. Li, Assessment of failure criteria and damage evolution methods for composite laminates under low-velocity impact, Composite structures 207 (2019) 727–739 (Q1, IF: 6.3, citations: 138). doi:10.1016/j.compstruct.2018.09.093
45. H. Liu, B. G. Falzon, **W. Tan**, Predicting the compression-after-impact (cai) strength of damage-tolerant hybrid unidirectional/woven carbon-fibre reinforced composite laminates, Composites Part A: Applied Science and Manufacturing 105 (2018) 189–202 (Q1, IF: 8.7, citations: 91). doi:10.1016/j.compositesa.2017.11.021
46. B. Falzon, **W. Tan**, Predicting impact damage, residual strength and crashworthiness of composite structures, SAE International Journal of Materials

and Manufacturing 9 (3) (2016) 718–728 (Q4, IF: 0.8, citations: 14). doi:10.4271/2016-01-0497

47. H. Liu, B. Falzon, G. Catalanotti, **W, Tan**, An experimental method to determine the intralaminar fracture toughness of high-strength carbon-fibre reinforced composite aerostructures, The Aeronautical Journal (2018) 1–19 (Q1, IF: 1.3, citations: 32). doi:10.1017/aer.2018.78

(3) Data-Driven Optimisation of Sustainable Composite Materials

48. H. Kansara, S. F. Khosroshahi, L. Guo, M. A. Bessa, **W. Tan***, Multi-objective bayesian optimisation of spinodoid cellular structures for crush energy absorption, Computer Methods in Applied Mechanics and Engineering 440 (2025) 117890, (**Q1, IF: 6.9, NO.1 journal in Computational Mechanics**, a novel contribution to use AI method (multi–objective Bayesian optimisation) to optimise the architected materials considering the material plasticity). doi:10.1016/j.cma.2025.117890
49. J. Fu, **W. Tan***, Stochastic reconstruction of multiphase composite microstructures using statistics-encoded neural network for poro/micro-mechanical modelling, Computer Methods in Applied Mechanics and Engineering 441 (2025) **(Q1, IF: 6.9, NO.1 journal in Computational Mechanics**, a new **AI** framework for stochastic reconstruction of composites. A high–fidelity tool to reconstruct multiphase microstructures for image–based poro/micro–mechanical analysis). doi:10.1016/j.cma.2025.117986
50. J. Fu*, **W. Tan***, D. Xiao*, X. Zhuang*, Computational intelligence in stochastic reconstruction of porous microstructures for image-based poro/micro-mechanical modeling, Archives of Computational Methods in Engineering (2025) 1–69. (**Q1, IF: 12.1, An invited review paper from the editor**. This review presents a comprehensive examination of stochastic reconstruction methodologies, spanning traditional algorithm–based methods and emerging AI–based approaches) doi:10.1007/s11831-025-10313-9

(4) Papers under review

1. A. Restasari, S. Pal, J. Briscoe, K. Akutagawa, R. Spontak, J. Busfield*, **W. Tan***, Decoding microstructure–property relationships in poly(urethane–urea) segmented copolymers in the presence of a selective plasticizing agent, ACS Macromolecules (2026) (under review)
2. M. Rui, **W. Tan***, Coupled electro-mechanical degradation of carbon fibre–lfp structural batteries under low-velocity impact: Implications for electric vehicle safety, eTransportation (2026) (under review)
3. K. Hirak, **W. Tan***, Inverse design of cellular composites for targeted nonlinear mechanical response via multi-fidelity bayesian optimisation, Composite Part B (2026) (under review)

(5) Book Chapters and Patent

1. B. G. Falzon, **W. Tan**, Virtual testing of composite structures: progress and challenges in predicting damage, residual strength and crashworthiness, in: The structural integrity of carbon fiber composites, Springer, Cham, 2017, pp.

699–743
2. J. Tan, **W. Tan**, Y. Liu, Z. Tan, A new extracorporeal magnetic driving system for an axial flow blood pump, cN Patent CN 102500002 B (Oct. 27 2011)

(6) Conference Presentations and Proceedings

1. **W. Tan***, **Albert Cardon Plenary Lecture: Bridging Mechanics and Machine Learning in Composite Design and Optimisation**, in: European Conference on Composite Materials (ECCM21), Nantes, France (1100+ international audience), 2024
2. **W. Tan***, H. Kansara, J. Fu, M. Besaa, Data-driven optimisation of energy-absorbing cellular composites, in: 26th International Congress of Theoretical and Applied Mechanics (ICTAM 2024), Daegu, South Korea, 2024
3. **W. Tan***, Modelling moisture-assisted fracture and liquid-solid impact in composite materials using phase field method, in: 9th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS2024), Lisbon, Portugal, 2024
4. **W. Tan**, Phase field modelling of the hygroscopic failure behaviours of composite materials: the role of moisture, in: ICCM23, Belfast, 2023
5. **W. Tan**, Phase field modelling the hygroscopic failure behaviours of composite materials, in: UKACM2023, University of Warwick, 2023
6. W. Wang, **W. Tan***, Mechanical performance of carbon nanotube film under high-speed impact loading, in: ICCM23, Belfast, 2023
7. S. Khosroshahi, **W. Tan***, Data-driven topology optimisation of energy absorbers, in: ICCM23, Belfast, 2023
8. **W. Tan***, H. Kansara, M. Liu, Y. He, Inverse design of shape-morphing structures based on functionally graded elastomer composites, in: Rubber Conference 2023, University of Edinburgh, 2023
9. A. Restasari, A. Kaur, K. Akutagawa, J. J. C. Busfield, **W. Tan***, Evaluation of mechanical and self-healing properties of poly(urethane-urea) compounds for wind turbine coating application, in: Rubber Conference 2023, University of Edinburgh, 2023
10. S. Khosroshahi, H. Kansara, M. Bessa, **W. Tan***, Data-driven framework for topology optimisation of energy absorbers, in: European Solid Mechanics Conference 2022, Galway, Ireland, 2022
11. **W. Tan***, Multiscale modelling the fracture behaviour of composite materials, in: UK Association for Computational Mechanics 2022 (UKACM2022), Nottingham, 2022
12. H. Kansara, M. Liu, Y. He, S. Kumar, **W. Tan***, Inverse design of functionally graded composites for morphing structures, in: 18th European Mechanics of Materials Conference (EMMC18), Oxford, 2022
13. **W. Tan**, J. Stallard, C. Jo, M. D. Volder, N. Fleck, The mechanical and electrochemical properties of structural power composites, in: 25th International Congress of Theoretical and Applied Mechanics , 2021
14. E. G. Ulloa, J. Busfield, N. Pugno, **W. Tan***, Thermo-mechanical modelling on lithium ion battery cells, in: UK Association of Computational Mechanics (UKACM) 2021 conference, 2021

15. **W. Tan**, Towards structural solid-state pseudocapacitors: the electrochemical and mechanical behaviour of carbon nanotube-polyaniline composites, in: ICCS23 & MECHCOMP6, Porto, 2020
16. **W. Tan**, The mechanical and energy-storage properties of carbon nanotube-polymer composites, in: International Workshop on Graphene and Carbon Nanotubes in Experimental Mechanics, Manchester, 2019 (Invited speaker)
17. **W. Tan**, H. Tankasala, N. A. Fleck, The stiffness and strength of epoxy-infilled carbon-nanotube mats, in: 10th European Solid Mechanics Conference, Bologna, Italy, 2018
18. B. Falzon, **W. Tan**, Predicting impact damage, residual strength and crash-worthiness of composite structures, SAE International Journal of Materials and Manufacturing 9 (3) (2016) 718–728 (Q4, IF: 0.8, citations: 14). doi:10.4271/2016-01-0497
19. **W. Tan**, B. G. Falzon, L. N. Chiu, M. Price, Numerical prediction of the low-velocity impact damage and compression after impact strength of composite laminates, in: IOP Conference Series, Vol. 74, IOP Publishing, 2015, p. 012015

20+ Plenary and Invited Talks

- Delivered a **plenary** conference lecture "Bridging mechanics and machine learning in the composite design and optimisation", on invitation from Prof. Christophe Binetruy, July 2024, ECCM21, Nantes. (Albert Cardon Plenary Lecture, ESCM Young Researcher Award 1200 attendees)
- Delivered an **invited** conference lecture "Inverse Design and Additive Manufacturing of Functionally-Graded Composites", on invitation from Dr. Mingchao Liu, August 2024, ICCES30, Singapore.
- Delivered an **invited** seminar "Designing Resilient Wind Energy Materials: From Leading-Edge Erosion to Multi-Material Optimisation", University of Cambridge, Oct 2025, invited by Prof. Fehmi Cirak.
- Delivered an **invited** seminar "Bridging mechanics and machine learning in the design and optimisation of materials", on invitation from Dr. Tim Hagmen, March 2025, University of Oxford.
- Delivered an **invited** seminar "Inverse design of architected materials from mechanics-based method to data-driven methods", on invitation from Prof. Burigede Liu, Dec 2024, University of Cambridge.
- Delivered an **invited** seminar "Bridging mechanics and machine learning in the design and optimisation of lightweight materials", on invitation from Prof. Susmita Naskar, October 2024, University of Southampton.
- Delivered an **invited** "Bridging mechanics and machine learning in composite design and optimisation", on invitation from Prof. Stefan Szyniszewski, March 2024, Durham University.
- Delivered an **invited** webinar "Mechanics of composite materials: from load-bearing to shape-morphing", SASCOM Seminar Series, on invitation from Prof. Gilles Lubineau, Nov 2022, Saudi Arabia.

- Delivered an **invited** webinar "Multiscale modelling of composite materials", Campus Arts et Métiers de Metz, on invitation from Dr. Francis Praud, May 2022, France.
- Deliver an **invited** talk "The mechanical and energy-storage properties of carbon nanotube-polymer composites", at University of Manchester, on invitation from Dr. Daniel Mulvihill, June 2019, UK
- Delivered an **invited** lecture "Mechanics of composite materials: From load bearing to shape morphing", Materials Engineering and Mechanics Seminars, Imperial College London, on invitation from Dr. Emilio Martínez-Pañeda, April 2022, UK.
- Deliver an **invited** talk "Progress in composite damage modelling", at Wuhan University, on invitation from Prof. Sheng Liu, May 2019, China
- Deliver an **invited** talk "Mechanics of composite materials: From load bearing to energy storage", at Southern University of Science and Technology, on invitation from Prof. Yijun Liu, May 2019, China
- Deliver an **invited** talk "Multiscale modelling of composites materials", at Central South University, on invitation from Prof. Kui Wang, April 2018, China
- Deliver an **invited** talk "Crushing modelling of composites structures", at Hunan University, on invitation from Prof. Guangyong Sun, April 2018, China
- Delivered an **invited** "Properties of Carbon nanotube and their composites", Micromechanics seminar, University of Cambridge, on invitation from Prof. Norman Fleck, October 2017, UK.
- Delivered an **invited** "Advanced Damage modelling of composite aerostructures", Huazhong University of Science and Technology, on invitation from Prof. Renfu Li, December 2016, China.
- Delivered an **invited** "Advanced computational modelling of composite aerostructures", Northwestern Polytechnical University, on invitation from Prof. Yongjie Zhang, December 2016, China.
- Delivered an **invited** "Modelling the behaviour of thermoplastic composite under crushing loading", IMDEA material institute, on invitation from Dr. Claudio Lopes, April 2016, Spain.
- Delivered an **invited** "Virtual testing of composite aerostructures", Beihang University, on invitation from Prof. Zixing Lu, January 2015, China.
- Delivered an **invited** "Damage modelling of composite aerostructures", Shanghai Jiaotong University, on invitation from Prof. Hai Wang, January 2015, China.
- Delivered an **invited** webinar "Multiscale modelling of composite materials: from load-bearing to shape-morphing", Dalian University of Technology, on invitation from Prof. Bin Niu, May 2022, China.

Research Impact Summary

Dr Tan's research advances sustainable materials technology through the design of durable, repairable, and circular material systems for aerospace, energy, and infrastructure applications. By integrating materials development with mechanics-informed modelling and AI-enabled optimisation, his work enables sustainability-by-design, accelerating materials innovation while reducing material waste, extending service life, and supporting net-zero objectives. He has published over 50 peer-reviewed articles (approximately 3,000 citations, H-index 25) and secured more than £2 million in competitive research funding, including an **ERC Starting Grant** and an **EPSRC New Investigator Award**.

His research has delivered strong industrial and translational impact through sustained collaborations with industry partners, including NSG Group and RSSL, leading to a joint patent and the translation of materials and mechanics-enabled innovation into industrial practice. Through the **Henry Royce Institute Industrial Collaboration Programme**, his work supports the translation of advanced materials from laboratory-scale development to field deployment, bridging materials design, processing, and real-world performance under industry-relevant conditions.

In education, Dr Tan has made significant contributions through innovative, materials-focused teaching that bridges fundamental principles with real-world engineering applications. He leads the Failure of Materials module, recognised with the QMUL Education Excellence Award, where he has introduced **hands-on, project-based learning** centred on materials behaviour, damage, and failure, enabling students to connect theory with experimental evidence and practical design decisions. His broader educational impact includes the development of engaging undergraduate teaching that integrates mechanics and materials concepts, as well as international outreach through his open-access YouTube channel, *Mechanics for Engineers*, which has reached over 100,000 views worldwide.

Dr Tan plays an active leadership role in the international materials and mechanics communities through service on the executive board of UKACM and leadership roles within IoM3 and ICCM, contributing to research strategy, industry engagement, and the mentoring of early-career researchers addressing challenges in sustainability, safety, and structural reliability. He is an elected **Fellow of IoM3** and is strongly committed to outreach, actively engaging primary and secondary school students to inspire interest in science, engineering, and sustainable technologies.