SCHOLARLY PUBLICATIONS
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Journal Name: IEEE Transactions on Consumer Electronics **IF: 10.9**

Title: Federated Learning-Enabled Digital Twins for Privacy-Preserving Cardiovascular Disease Detection in Consumer Electronics

Author: Othman, S.B.; Chakraborty, C.; Singh, S.; Frikha, M.A.

Details: December 2025

Abstract: Digital Twins (DTs) hold transformative potential for precision cardiology by enabling patient-specific modeling of coronary hemodynamics, electrophysiological dynamics, and myocardial mechanics through multi-modal data fusion. However, their clinical deployment is impeded by critical challenges: privacy vulnerabilities in centralized data aggregation, computational inefficiency of high-fidelity simulations, algorithmic bias across demographic cohorts, and lack of robustness in distributed environments. To address these limitations, we propose QuantumFedDT-CVD, a quantum-enhanced, federated learning-enabled digital twin framework for privacy-preserving cardiovascular disease detection using consumer-grade electronics. The framework enables decentralized training across edge and clinical systems, integrating real-time physiological signals with electronic health records, genomic profiles, and medical imaging, without exchanging raw patient data. At its core, QuantumFedDT-CVD employs physics-informed quantum-variational neural operators to model non-Markovian cardiovascular dynamics with O(n log n) spectral efficiency. Evaluated on the UK Biobank cohort augmented with real-world data from 500 CVD patients, QuantumFedDT-CVD achieves an AUC-ROC of 0.94 for early adverse event prediction and a Dice score of 0.92 for cardiac segmentation. It operates at 4.2 × 108 FLOPs/round, 0.8 MB/round communication overhead, and 550 J/round energy consumption under-differential privacy. The system scales to 200 institutions, tolerates up to 40% Byzantine clients, and demonstrates a measured quantum advantage factor of 3.8, paving the way for efficient, secure, and equitable remote cardiovascular monitoring.

URL: https://ieeexplore.ieee.org/document/11259495

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Journal Name: Fuel **IF: 7.5**

Title: Computational modelling of pulverized coal combustion to explore the effect of particle size on overall combustion characteristics and NO formation within a limited time frame

Author: T.K., Sahoo, Tarak Kumar; P., Ghose, Prakash

Details: Vol. 405, February 2026

Abstract: Pulverized coal combustion is widely used for power generation and metal extraction. The movement of coal particles within the combustion chamber and their size play an important role in obtaining proper combustion and pollutant formation, like NOx. In this work, the thermo-chemical behaviour of particles of different sizes within a certain travelling period is analysed intensively with the help of 3-D CFD simulations. A large-scale laboratory furnace is considered for this work, and a few results of the CFD work are verified against the experimental results. From the investigation, it is observed that the smaller particles absorb heat at a faster rate; hence the devolatilization process begins early. The devolatilization process occurs at a lower temperature for large particles, and its rate becomes highest at 1200 K of gas temperature. The devolatilization process continues at a higher temperature for smaller particles. A similar trend is also observed for the char reaction rate. The thermal NO rate is negligible for the larger particle, irrespective of gas or particle temperature, whereas the smaller particles contribute the maximum amount of Thermal NO. The Prompt and Fuel NO rate is significant for the larger particles, whereas the rate of both Prompt and Fuel NO is much higher for the smaller particles, and it occurs at a higher temperature. Therefore, the smaller particles dominate the overall NO contribution.

URL: https://www.sciencedirect.com/science/article/abs/pii/S001623612502294X?via%3Dihub

SCHOLARLY PUBLICATIONS
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Journal Name: International Communications in Heat and Mass Transfer **IF: 6.4**

Title: Thermal synergy at the nanoscale: A review on hybrid nanofluids

Author: Mukherjee, S.; WciÅ›lik, S.; Kotrys-DziaÅ‚ak, D.; Khadanga, V.; Mishra, P.C.

Details: Volume 169, December 2025

Abstract: In recent years, hybrid nanofluids (HNFs)—suspensions of dissimilar nanoparticles in base fluids —have attracted significant research interest due to their potential to enhance thermal performance through synergistic effects between constituent nanoparticles. A comprehensive understanding of their thermophysical behavior is essential for successful integration in advanced heat transfer and energy systems. This review presents a detailed and up-to-date analysis of recent advancements in the characterization and modeling of HNFs, with a balanced emphasis on both theoretical approaches and experimental findings. The novelty of this work lies in its systematic comparison of classical models and modern formulations, as well as its synthesis of diverse experimental data into a coherent framework. Unlike previous reviews, this paper critically examines the role of particle composition, shape, concentration, and interaction mechanisms on thermal conductivity, viscosity, and stability. Key challenges such as nanoparticle agglomeration, measurement inconsistencies, and scale-dependent behavior are highlighted. In addition, limitations of existing predictive correlations are discussed. The review concludes by identifying current research gaps and outlining promising future directions, aiming to support the development of more accurate models and effective applications of HNFs in thermal management technologies.

URL: https://www.sciencedirect.com/journal/international-communications-in-heat-and-mass-transfer

SCHOLARLY PUBLICATIONS
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Journal Name: Surface and Coatings Technology **IF: 6.1**

Title: Insight into the influence of ceramic phase (h-BN) in optimizing the tribological behavior of NiMoAl based coatings in broad range of temperatures (25 Â°Câ€“800 Â°C) deposited by cold spray

Author: Gautam, R.K.S.; Tripathi, V.M.; Mishra, S.; Gautam, J.K.; Tyagi, R.; Jha, P.; Ali, S.

Details: Volume 518, Issue 132918, December 2025

Abstract: The current research work involves the deep analysis and influence of h-BN as reinforcement in NiMoAl matrix for developing advanced coating materials, which could perform effectively in adverse conditions, i.e., high temperature, high contact stresses and pressure. The tribological properties of cold sprayed NiMoAl based coatings containing varying amounts of reinforcements, such as NiMoAl-WS_2-Ag (NWAB0), NiMoAl-WS_2-Ag-hBN (5 wt%) (NWAB5), and NiMoAl-WS_2-Ag-hBN (10 wt %) (NWAB10) were evaluated employing a high temperature tribometer over a broad temperature range (25 °C to 800 °C). The tribo-tests were performed against alumina balls (6.2 mm diameter) as the counter face material. The micro-hardness values of the formulated coatings decrease as the h-BN content increases. Particularly, the coating without h-BN (NWAB0) has shown the maximum micro-hardness value of 435 $HV_{0.5}$. However, the h-BN reinforced coatings have shown continuous lowering in coefficient of friction (COF) and wear rate from room temperature (RT) 25 °C to 800 °C. Among the coatings, NWAB5 has shown superior lubricity and COF dropped from 0.27 to 0.13 as the temperature increased from RT to 800 °C. The pragmatic behavior has been explained on the basis of the formation of sustainable tribo-layers (NiO, $NiMoO_4$, WO_3 and AgMoxOy), along with the synergistic action of optimal content of h-BN, which may have stimulated the greater extent of lubricious oxides and improved the wear resistance of the coatings.

URL: https://www.sciencedirect.com/science/article/pii/S0257897225011922?via%3Dihub

SCHOLARLY PUBLICATIONS
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Journal Name: Discover Materials **IF: 5.1**

Title: A review on advancements in HVOF sprayed coating of MCrAlX nicocraly innovations in processing performance applications and high temperature durability

Author: Anusha, K.; Chakrabarty, S.; Chandra Routara, B.C.; Kumar, N.; Guha, S.

Details: Volume 5, Issue 1, December 2025

Abstract: The High Velocity Oxyfuel (HVOF) system has established itself as a leading process for depositing NiCoCrAlY and MCoCrAlX coatings, which serve as a crucial bond coat in the Thermal Barrier Coating system (TBC) for high temperature applications. By providing exceptional protection against hot corrosion, oxidation and wear, these coating have become ideally suited for aerospace components and gas turbine applications. Recent advancements have primarily focused on enhancing coating performance through strategies such as pre-oxidation, implementation of multilayers and graded structures, vacuum heat treatment, rare earth doping and oxide dispersion strengthening. These modifications ultimately result in improved grain refinement, adhesion, superior thermal stability and enhanced mechanical properties. This article will provide significant development in HVOF-sprayed MCrAlX/NiCoCrAlY coatings with particular focus on microstructural evolution, durability and process optimization under extreme environmental conditions.

URL: https://link.springer.com/article/10.1007/s43939-025-00416-2

SCHOLARLY PUBLICATIONS
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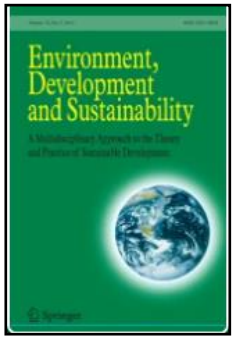
Journal Name: Environment, Development and Sustainability **IF: 4.2**

Title: Assessment of Indian consumers' green purchase intention: an integration of theory of planned behaviour and meta-analysis

Author: Panda, D.; Singhal, D.; Jena, S.; Tripathy, S.

Details: Volume 27, 2025

Abstract: Globally, there is a rapid rise in awareness of environmental degradation and its harmful effects. This awareness not only motivates businesses to produce environmental-friendly goods but also inspires academicians and practitioners to comprehend the customer's environmental-friendly purchasing behaviour. This research examines past studies on Indian consumers' green purchase intentions and explores prominent behavioral intention factors to improve theoretical comprehension of consumers' purchase behaviors. The objective of this research is to quantify the relationship between predictors of the theory of planned behavior and green purchase intention, and also examine the contribution of additional predictors to green purchase intention. The meta-analysis technique is used in quantifying, and drawing general and trustworthy conclusions. The review of the extant literature is systematically conducted and thirty studies are deemed appropriate for the meta-analysis. The findings reveal key factors that influence consumers' decision-making towards the purchase of green products. The outcomes of the meta-analysis distinctly delineate that attitude, subjective norms, perceived behavioral control, and environmental consciousness tend to maintain a positive correspondence with green purchase intention. The findings also indicate that attitude has the most substantial influence on purchase intention, followed by perceived behavioral control, subjective norms, and ultimately environmental consciousness. Marketers can use the information gleaned from the findings to come up with strategies that will help them get more people to buy green products and accept them more readily.



URL: https://link.springer.com/article/10.1007/s10668-024-04897-8

SCHOLARLY PUBLICATIONS
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Journal Name: Industrial & Engineering Chemistry Research **IF: 3.9**

Title: Mechanism of Free Surface Vortex (FSV) Formation in the Presence of Free Stream flow of Air

Author: Rana, A; Shah, AY; Rana, BK

Details: Volume 64, Issue 47, November 2025

Abstract: This study reports a computational analysis of the mechanism of free surface vortex (FSV) formation and air entrainment induced by a spinning disc in the presence of horizontal crossflow of the gaseous phase. The genesis of FSV is characterized by varying the submersion height (H/D), strength of crossflow (Ref), and rotational flux (Fr). A detailed investigation is conducted on the temporal evolution and steady characteristics of FSV using both qualitative and quantitative approaches. The configuration of FSV is noticed to be bulkier as the strength of crossflow increases for a constant rotation speed (Fr) and submersion height (H/D). Furthermore, the vortex deflects more with respect to the longitudinal axis of the disc as Ref increases for a fixed Fr and H/D. Thus, the increasing gradient maximum deflection (Xmax) against Fr is observed to be steeper at higher Ref in comparison to a lower Ref. A scattered regime map is developed to distinguish three critical interfacial configurations of FSV. Again, the configurations of FSV are characterized by considering the role of gravitational (described by Bond number, Bo) and viscous forces (specified by Morton number, Mo). A bulky FSV is observed at a lower value Bo, whereas the FSV configuration progressively thins down as the magnitude of Bo increases. Crossflow deflects the trailing junction more effectively at a lower Mo than at a higher Mo.

URL: https://pubs.acs.org/doi/10.1021/acs.iecr.5c03106

SCHOLARLY PUBLICATIONS
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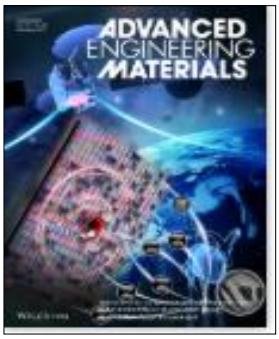
Journal Name: Advanced Engineering Materials **IF: 3.3**

Title: Unveiling Relationship between Crack Evolution through Long-Term Ageing and Mechanical Properties of Cold-Sprayed Ni-Base Superalloys: Experimental Characterization and Evidence through Finite Element Modeling

Author: Vadani, M.; Raj, S.; Mondal, C.; Sun, W.; Chakrabarty, S.; Msolli, S.; Tan, A.W.-Y.; Bhowmik, A.

Details: November, 2025

Abstract: This work examines the effects of prolonged heat-treatment on the microstructure and mechanical characteristics of cold spray (CS) IN718. The heat treatment reduced coating porosity from 3% to 0.8%. The ageing treatment results in a synergistic effect of precipitation hardening from intermetallic phases and carbides, with a simultaneous reduction in the work-hardened microstructure through recovery, manifested as reduced dislocation density in the coating. The as-sprayed coatings exhibit reduced cohesive strength and toughness, along with a significant anisotropy in tensile characteristics, which is a primary objective of the study. The causes of the mechanical anisotropy in the CS coatings have been elucidated. The postprocessing resulted in an increase of ≈120% in cohesive strength and ≈75% in ductility of the coating due to the aforementioned alterations in microstructures. The tensile response of the coatings in both as-sprayed and heat-treated conditions has been analysed using numerical modelling, which utilizes crack widths and their densities within the coating. The model clearly shows that cracks perpendicular to the loading affect tensile strength. The model agrees with experimental tensile strength data and accurately predicts crack widths and densities in each anisotropic direction. The finite element models reveal an empirical connection between tensile strength and crack size.



URL: https://advanced.onlinelibrary.wiley.com/doi/10.1002/adem.202501848

SCHOLARLY PUBLICATIONS
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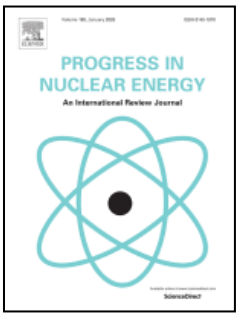
Journal Name: Progress in Nuclear Energy **IF: 3.2**

Title: A critical analysis of correlations for saturated nucleate pool-boiling heat transfer over vertical tubes and tube bundles: Development of improved models

Author: B.B., Sha, Bibhu Bhusan; R.L., Mohanty, Rajiva Lochan; M.K., Das, Mihir Kumar

Details: Volume 190, January 2026

Abstract: Pool boiling over vertical tubes is vastly experienced in the nuclear industry, where nucleate boiling plays a crucial role in transferring heat. In this context, many experiments have been done in the recent past and developed various correlations for boiling heat transfer. The correlations are influenced by system parameters and the geometrical configuration of the surfaces. Therefore, a wide range of experimental data for saturated pool boiling over vertical tubes and their bundles are taken into consideration to examine the prediction accuracy of various correlations. The prediction errors of various correlations are reported both in tabular and graphical forms. Keeping the most critical parameters in mind, this article proposes two new semi-empirical correlations for predicting the heat transfer coefficient over vertical tubes and their bundles. These developed correlations are able to predict saturated boiling heat transfer coefficients over the tube bundle and single tube data within ±15 % and ±20 %, respectively.



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