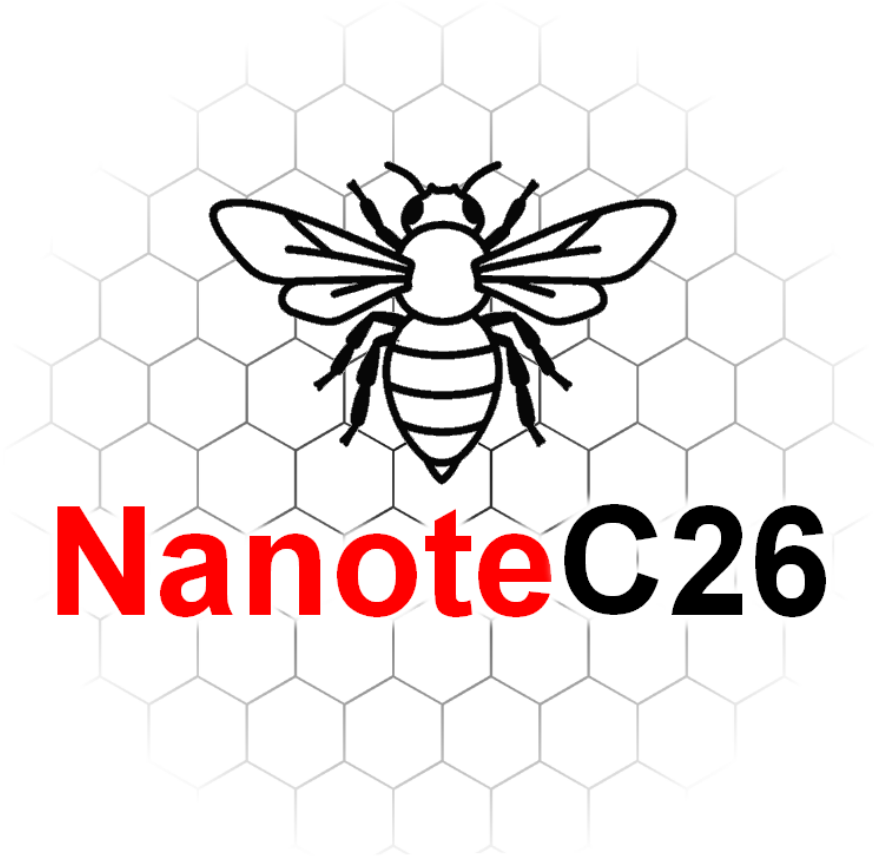

BOOK OF POSTER ABSTRACTS

NanoteC26 Conference

1-4 September 2026

Poster abstracts supplied by presenting authors

Contents

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Inert Liquid Phase Exfoliation of TaS_2

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Liquid Phase exfoliation (LPE) is a versatile technique that is used to produce large quantities of 2-dimensional (2D) materials from layered crystals [1]. 2D materials produced by LPE are preferred over other expensive methods where scalability and cost is more important than higher performance. Despite extensive use of LPE for exfoliating a large number of 2D materials, still much attention is needed to study degradation kinetics and thermodynamics under ambient conditions to assess their suitability for real life applications for a number of these 2D materials. In this research we used different stocks of TaS_2 powders and exfoliated 2-dimensional sheets using LPE under inert environment [2], and studied the kinetics and degradation over time. We compare the exfoliated sheets obtained via bath sonication under argon flow and tip sonication in glovebox followed by size selection using liquid cascade centrifugation. We used the exfoliated sheets for film formation using Liquid-Liquid Interface deposition which were subsequently heat treated to convert TaS_2 films into oxides which can be a suitable candidate for using as dielectrics. Then we used electrochemical exfoliation method [3] to get nanosheets with higher aspect ratio and used these sheets to make pinhole free films to assess the suitability of these films as dielectrics.

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Recycling of thermoplastic polymer nanocomposite

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The rising demand for eco-friendly polymer materials has sparked considerable interest in recycling and improving the performance of engineering thermoplastics. This research examines how carbon-based nanofillers affect the structural, thermal, mechanical, and moisture absorption properties of mechanically recycled polyamide 6 (PA6). Multi-walled carbon nanotubes (MWCNTs) and graphene nanoplatelets (GNPs) were added to PA6, and the resulting nanocomposites underwent several reprocessing cycles to assess the impact of recycling on their performance.

Characterization of the nanocomposites was conducted through tensile testing, differential scanning calorimetry (DSC), and X-ray diffraction (XRD). The findings showed that adding carbon nanofillers altered the crystallization behavior and mechanical properties of PA6, while also reducing some of the degradation typically seen with repeated processing. Analyses using XRD and DSC revealed modifications in the crystalline structure and thermal transitions of the recycled materials, indicating that interactions between nanofillers and the matrix influenced crystal formation during processing.

In summary, the results illustrate that carbon nanofillers can be effectively employed to improve the performance and longevity of recycled PA6, aiding in the creation of high-value, sustainable polymer nanocomposites for engineering uses. This study sheds light on the connection between structural changes induced by recycling and the multifunctional performance of PA6-based

Evaporation-Driven Self-Assembly of Photonic Crystals Incorporating Nanomaterials

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In nature, butterflies generate vibrant structural colours through periodic micro/nanostructures that create a periodic variation in refractive index. Similar photonic structures are also found in opals and chameleon skin. Researchers can replicate these optical effects using synthetic photonic crystals (PCs) with long-range order [1]. This poster reviews a scalable approach for fabricating synthetic PCs via evaporation-driven self-assembly of soft polymer colloids infused with nanomaterials. Forces generated during solvent evaporation assemble the polymer colloids into a highly ordered crystal lattice while locking the nanomaterials at the interstitial sites, forming a segregated network [2]. Incorporating nanomaterials enables the photonic band structure to be tuned to become sensitive to external stimuli such as mechanical deformation and temperature [3]. This solution-processing approach provides a simple route for templating nanomaterials within photonic crystals and offers new opportunities for the development of visual sensing technologies.

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Synergistic interface engineering of transition metal-doped ReS_2/Ti_3C_2 MXene hybrid for boosted electrocatalytic HER: Experimental and DFT insights

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The hydrogen evolution reaction (HER) is being broadly explored and advanced due to its use as a favorable substitute for fossil fuels to harvest renewable energy. The advancement in HER is to introduce an efficient electro-catalyst apart from platinum-based benchmark catalyst, with lower commercial cost. Transition metal sulfides (TMS) have been a fascinating rising consideration as promising catalysts for the electrochemical conversion of energy. The alteration of the electronic configuration of TMS by means of the integration of metal heteroatoms, followed by the preparation of composites utilizing nanosheets of MXene noted for their elevated electrochemical surface area, results in a considerable augmentation of active catalytic sites and boost in the electrocatalytic performance of HER. A heterostructured noble metal free electrocatalyst, Mo-doped ReS_2@Ti_3C_2 MXene composite (**MRT**) was synthesized via a typical hydrothermal method. The electrocatalytic HER performance of **3-MRT** composite demonstrates boosted results over non-doped ReS_2@Ti_3C_2 MXene composite as well as pristine ReS_2 and Ti_3C_2 MXene, delivered a current density of 10 mA cm^{-2} at an overpotential of 66 mV for HER and shows excellent stability for 50 h. This study shows the importance of hetero-atom doping and exposes routes for non-noble metal-based electrocatalytic materials suitability for H_2 production".

Characterising the Morphology and Electrical Properties of Printed Nanosheet Networks Across Different Printing Techniques

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The main abstract text, please stick to *one page maximum* [1-2]. A figure or table is also fine.

Solution-processed inks based on two-dimensional (2D) nanosheets have the potential to enable the next generation of low-cost printed electronics[1]. However, device performance is fundamentally constrained by how nanosheets assemble into disordered networks during deposition. High electrical resistances at inter-nanosheet junctions (R_J) often vastly exceed intrinsic nanosheet resistance values (R_{NS}), leading to junction-limited charge transport and devices that perform well below their theoretical limits. Recently, printed nanosheet films with $R_J/R_{NS} < 1$ have been reported[2], driven by well- aligned, low-porosity, and morphologically uniform networks. However, the influence of printing technique on these properties has not been comprehensively investigated. In this study, using high aspect-ratio MoS_2 nanosheets[3] as a model system, we compare four different deposition techniques: spray coating, spin coating, dip coating, and liquid-liquid interfacial deposition (LLID). Electrical impedance spectroscopy (EIS) methodologies developed in our group are used to extract key network parameters, including R_J, R_{NS}, and homogeneity metrics from films produced using each method[4]. This provides a quantitative means to characterise and compare the electrical performance of 2D networks across different deposition techniques.

Significant variation in network morphology and electrical performance is observed across deposition methods. LLID films exhibit the lowest junction-to-nanosheet resistance ratios ($R_J/R_{NS} \sim 1.5$) and the highest network order and homogeneity, consistent with highly aligned nanosheets and improved charge transport. In contrast, spray- and spin-coated films exhibit increased disorder and higher relative junction resistance, reflecting less controlled nanosheet assembly.

Polarised Raman spectroscopy was used to quantify nanosheet alignment via the Hermans orientation parameter independently. Strong correlation is observed between the Raman-derived alignment and impedance-derived network order metrics, linking direct morphological measurements to parameters extracted from EIS. Complementary optical analysis of the films further links spatial homogeneity to the extracted electrical descriptors, thereby establishing direct relationships between network morphology and impedance-derived transport parameters.

These findings demonstrate that EIS provides a rapid, single-measurement approach for extracting R_J, R_{NS}, and network order in printed nanosheet films. More broadly, this work provides a quantitative framework for comparing how deposition methods govern morphology and charge transport in 2D networks, accelerating the optimisation of nano-enabled printed electronic devices.

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Hybrid Graphene-Based Polymer Nanocomposites

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The development of multifunctional polymer composites is central to advancing lightweight materials for demanding engineering applications, where mechanical integrity, thermal performance, barrier behaviour and processability must be balanced.

This study investigates carbon-based fillers and hybrid reinforcement strategies in polyamide 6 (PA6) and polybutylene terephthalate (PBT), with particular emphasis on the relationships between processing, microstructure and macroscopic performance.

PA6 and PBT were examined alongside a range of carbonaceous reinforcements, including graphite, graphene nanoplatelets (GNPs), multi-walled carbon nanotubes (MWCNTs) and glass fibre, used individually and in hybrid combinations. A comprehensive experimental programme was employed, encompassing structural, thermal, mechanical and transport characterisation techniques to evaluate how filler morphology and composite architecture influence material behaviour across multiple length scales.

The results demonstrate that composite performance is strongly dependent on dispersion quality, interfacial interactions and filler organisation within the polymer matrix. Individual fillers provided targeted property enhancements, whereas the effectiveness of hybrid systems depended strongly on matrix selection and reinforcement strategy. In several cases, filler combinations produced non-additive behaviour, highlighting the importance of microstructural interactions in determining final properties.

To complement the experimental programme, data-driven and AI-assisted methodologies supported analysis, visualisation and interpretation of the generated datasets. Predictive modelling tools were developed to explore composition–property relationships and assess the potential of data-assisted approaches for guiding future materials design. These methods provided an interpretive framework alongside experimental evidence rather than replacing physical testing.

Overall, this work demonstrates the value of integrating experimental characterisation with data-assisted analysis to better understand structure–property relationships in multifunctional polymer nanocomposites.

Scalable and flexible light-emitting diodes based on colloidal 2D semiconductors

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Two-dimensional (2D) semiconductors are attractive materials for ultrathin, lightweight, and flexible light-emitting devices, yet existing 2D LEDs predominantly rely on mechanically exfoliated flakes or vapor-grown films that are incompatible with scalable manufacturing. [1] Here, we demonstrate fully solution-processed flexible visible light-emitting diodes based on colloidal MoS_2 monolayers produced by electrochemical exfoliation. A systematic investigation of solvent compatibility establishes an orthogonal processing strategy that enables sequential deposition of multi-layered vertical heterostructures without damaging underlying layers. To improve device performance, MoS_2 nanosheets are incorporated into a poly(N-vinylcarbazole) (PVK) nanocomposite emissive layer, simultaneously suppressing electrical leakage and enhancing optical out-coupling. Compared with MoS_2-only devices, the nanocomposite architecture reduces the turn-on voltage from approximately 6.2 V to 3.6 V while increasing the emitted irradiance by nearly an order of magnitude. The fabrication strategy is readily extended to colloidal nanosheets derived from synthetic MoS_2 and WS_2 crystals and is compatible with flexible PET substrates, where the devices exhibit stable electroluminescence during repeated mechanical deformation. These results establish a scalable platform for printed flexible 2D optoelectronics and provide practical design principles for future large-area colloidal light-emitting devices.

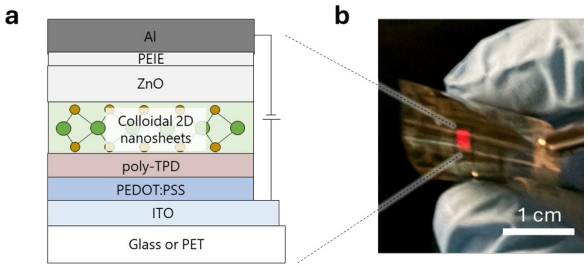

Figure. Colloidal 2D-LEDs. (a) Schematic demonstration of the device structure. (b) Photograph of a WS_2 based LED on a PET substrate during operation upon manual bending.

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Flash Reduction of Graphene Oxide–Alginate Films towards Conductive Composite Networks

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Graphene oxide (GO) is widely used in polymer composites due to its oxygen-containing functional groups, sheet-like structure and good processability. Alginate is a useful polymer matrix because it can form stable films and hydrogel networks. Combining GO with alginate provides a route to polymer–carbon composite materials with both structural support and carbon-based functionality. However, GO is intrinsically poorly conductive, so reduction is required to improve its electrical performance.

In this work, flash reduction was used as a rapid post-treatment method for GO–alginate composite films. The aim was to convert initially insulating GO–alginate films into conductive reduced graphene oxide (rGO)–alginate composite networks. Previous work has shown that flash reduction can reduce and pattern graphite oxide and its polymer composites [1]. Here, this approach is applied to GO–alginate films as a simple route towards conductive polymer–carbon networks.

After flash treatment, two-point electrical resistance measurements showed a clear change in electrical behaviour, with the films becoming measurably conductive. Scanning electron microscopy (SEM) was used to examine changes in surface morphology and composite network structure before and after flash reduction. Raman spectroscopy was used to analyse the D and G bands, which provide information on defects, disorder and changes in the sp^2 carbon network during reduction [2].

The current results show that flash reduction can modify both the electrical behaviour and carbon structure of GO–alginate composite films. SEM images indicate morphological changes after treatment, while Raman spectra show changes associated with the carbon network. These results suggest that flash reduction is an effective method for producing conductive GO–alginate-based composite films. Further work will investigate whether the flash-reduced films can be crosslinked into hydrogel networks while retaining useful electrical and mechanical properties.

Overall, this poster presents flash reduction as a fast and practical method for preparing conductive GO–alginate composite films. This approach may be useful for conductive patterns, flexible sensors and carbon-based hydrogel platforms.

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Green Phytofabrication of Silver Nanoparticles from Underexplored Cypriot Plants species with Tunable Antimicrobial, Antioxidant and Anticancer activity

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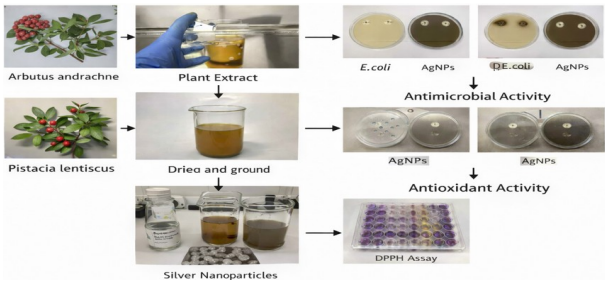

Abstract: Nanotechnology involves synthesizing, characterizing, and using nanostructured related materials for diverse applications. This nanomaterials possess at least one dimension in the nanoscale range (approximately 1–100 nm) [1]. At this scale, nanostructured materials exhibit distinct physicochemical properties that differ significantly from their bulk counterparts. Among its major properties is the high surface-to-volume ratio, which enhances surface free energy, adsorption capacity, and reactivity. Owing to these excellent properties, nanomaterials often display size-dependent changes in optical, magnetic, electrical, thermal, and mechanical properties. These properties can be aligned for specific applications in medicine, energy, electronics, and environmental science. Nanoparticles may also exhibit altered density, diffusivity, and chemical stability compared to bulk materials. The chemical stability and biocompatibility of nanoparticles produced from plant extracts demonstrate medicinal implications, rendering them suitable candidates for antibacterial and antioxidant activities [2]. Silver nanoparticles were synthesized in this study using extracts from *Arbutus andrachne* and *Pistacia lentiscus* leaf, and we examined their antioxidant, antibacterial and anticancer properties. This study presents the green synthesis of very stable silver nanoparticles, measuring around 90.87 nm and 78.26 nm, derived from the extracts of *Arbutus andrachne* and *Pistacia lentiscus*, respectively. The surface compositional analysis of the synthesized silver nanoparticles (AgNPs) was conducted using UV-visible

spectroscopy, Fourier transform infrared spectroscopy, X-ray diffraction, zeta potential analysis, energy dispersive X-ray spectroscopy, and scanning electron microscopy. Gas chromatography-mass spectrometry analysis was conducted to separate and detect the chemical components of the plants. The antimicrobial efficacy of AgNPs was demonstrated against *Escherichia coli* and *Enterococcus faecalis*. Both samples showed significant cytotoxicity against cancer cell line, with cell viability decreasing as AgNP concentration increased and it was observed that *A. andrachne* AgNPs exhibited stronger cytotoxic effects than *P. lentiscus*.

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Comparison of transferred vs. transfer-free graphene

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Graphene is the most established 2D material, facing numerous applications in future electronics for example as a sensor material. Chemical vapour deposition (CVD) is the method of choice for the production of high-quality graphene. [1] The prime synthesis method for these applications is the growth on copper foils. The production and processing have been optimised, and its reproducibility has become more reliable and are also being marketed by commercial companies. [2]

However, in particular the transfer processes of graphene or error-prone, does introduce defects and impurities and therefore remains a challenge for throughput and reliability. [3] Direct growth methods are thus highly sought after. The use of a high-temperature cold wall reactor allows for direct growth of graphene on sapphire. This technique enables transfer-free graphene growth on the target substrate and the established, yet error-prone, process of transferring CVD graphene grown on copper foils. Additionally, the use of sapphire allows processing at higher temperatures, which generally results in better graphitisation. [4, 5]

In this study, graphene grown directly onto sapphire using a showerhead reactor is compared with graphene that was first grown on copper in a cross-flow reactor and then transferred to sapphire. [6] Characterisation is carried out using AFM, SEM and Raman measurements. The Raman measurement indicates mostly single-layered graphene for both CVD-methods. Only probably due to the fact of the missing catalytic active surface the transfer-free graphene shows a higher defect density. Under an optical microscope, as well as in SEM, small, isolated surface particles are visible on the transfer-free graphene. AFM measurements reveal a height difference of a few tens of nanometres relative to the monolayer. Combined with their morphology and thickness, these observations suggest that the particles are attributable to carbonaceous residues formed during the CVD growth process, consistent with previous reports of similar graphitic surface features observed during direct graphene growth on sapphire. [5]

Over all the results show that the advantages of transfer-free graphene include the reproducibility of the fabrication process and more likely the ability to produce smaller, well-defined structures. In terms of structural quality, the graphene grown on copper foil is still better, but the transfer-free graphene is likely to be sufficient for most applications.

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corresponding paper in publication process (2026)

Sustainable Biomass-Derived Activated Carbon/PEDOT:PSS Composite Ink for Seamless Printing of Flexible Micro-Supercapacitors

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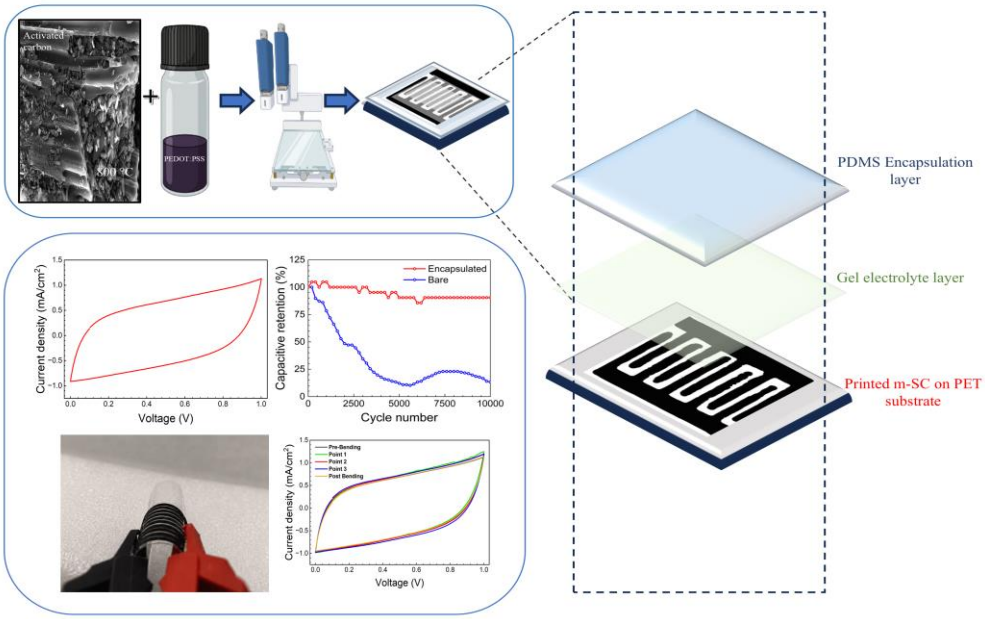
Sustainable and scalable energy storage technologies are critical for the advancement of flexible and wearable electronics. However, the development of environmentally friendly, printable electrode materials with high electrochemical performance and mechanical durability remains a significant challenge. In this work, we synthesise a biomass-derived conductive ink based on activated carbon (AC) obtained from sugarcane bagasse and mix it with the conducting polymer PEDOT:PSS for the fabrication of printed micro-Supercapacitors (m-SCs). AC synthesised at an optimised pyrolysis temperature of 800°C exhibits a high surface area of 649.3 $m^2\ g^{-1}$, a mesoporous structure with pore sizes of 5.08–6.03 nm, and a specific capacitance of 201.87 F g^{-1}. The composite ink formulation was systematically optimised through investigation of additive composition, carbon-to-polymer ratio, and printing layer count to achieve suitable rheological properties, excellent printability and electrochemical performance. Flexible m-SCs are fabricated by direct ink writing on polyethylene terephthalate (PET), employing a PVA/H_3PO_4 gel electrolyte and PDMS encapsulation for device protection. The devices deliver a high areal capacitance of 78 mF cm^{-2} and retain 95% of their initial capacitance after 10,000 charge-discharge cycles, demonstrating exceptional long-term electrochemical stability. Furthermore, the m-SCs exhibit excellent mechanical robustness, maintaining nearly identical CV curves under different bending angles indicating stable electrochemical performance under mechanical deformation. The synergistic combination of sustainable activated carbon and conductive polymer enables a low-cost, scalable, and environmentally friendly approach for high-performance printed energy storage devices. These findings further demonstrate the potential of high value waste-derived materials for next-generation wearable and printed electronics.



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Fullerene quantum magnets from first principles

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Molecules provide more tuneable building blocks than atoms [1,2] and can self-assemble into larger structures [3,4] with richer structural behaviours [5] for quantum devices. Using pure-carbon fullerene molecules that were believed to be non-magnetic [6], we show that magnetism in this material family can be induced purely by symmetry [7]. We can then use this pure-carbon magnetic material to design various quantum platforms, based on experimentally synthesised monolayers [8,9], to realise exotic quantum phenomena such as ferromagnetic Chern insulators [10], antiferromagnetic spin chain [11], altermagnetism and quantum spin liquid [12], as well as magnetoelectrics where spins can be controlled by electric fields. If time allows, I will also discuss my ongoing research that combines both atomic and molecular building blocks. With this approach, we can unlock even more exciting applications such as quantum timekeeping and quantum simulation.

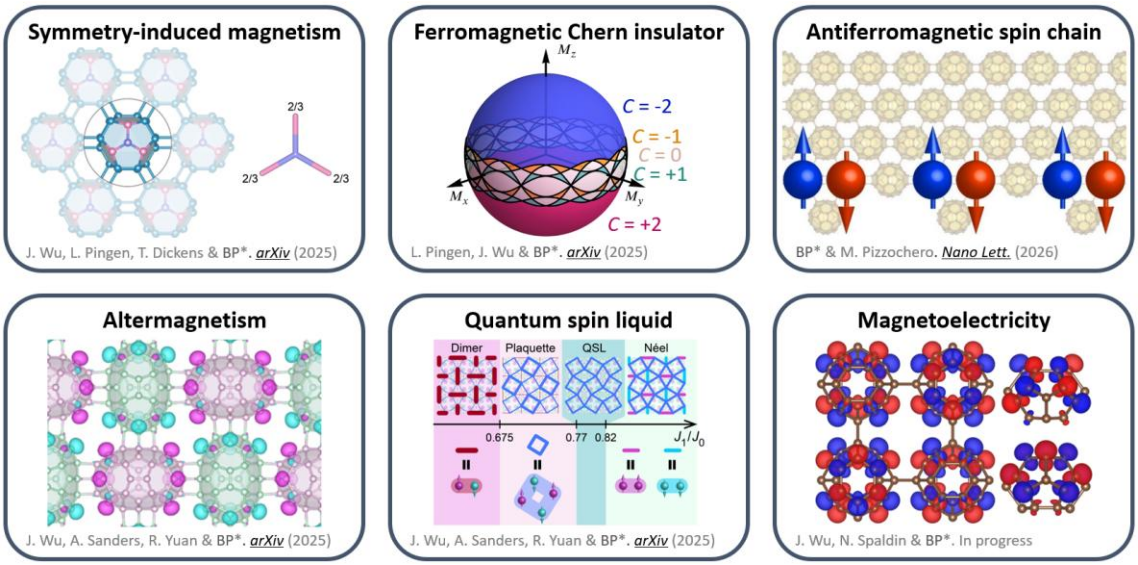

Figure. A zoo of magnetic fullerene monolayers.

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Spatially Separated Dual Floating-Gate Synaptic Memory Based on Multilayer SnS_2 for Neuromorphic Computing

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Abstract

Emerging two-dimensional (2D) van der Waals (vdW) heterostructures have opened new opportunities for next-generation memory and neuromorphic computing devices. In this work, we present a spatially separated dual floating-gate synaptic device built on a multilayer van der Waals heterostructure, with SnS_2 as the channel material, hexagonal boron nitride (h-BN) as the tunneling dielectric, and **1T′ WTe_2** and **1T′ $MoTe_2$** as engineered floating-gate layers that are spatially separated beneath a shared SnS_2 channel. The two floating-gate regions were characterized independently, and the **1T′ WTe_2** region emerged as the superior charge-storage layer. The device exhibits robust non-volatile memory characteristics, including a large memory window, stable program/erase operations, and excellent endurance and retention. The heterostructure enables efficient charge trapping and d-trapping due to optimized band alignment and strong interlayer vdW coupling. Synaptic functions such as potentiation and depression are demonstrated through controlled electrical pulse stimulation, enabling analog modulation of conductance. Furthermore, experimentally extracted conductance states are integrated into convolutional neural network (CNN) simulations using the Fashion-MNIST dataset, achieving high recognition accuracy (~92.5%). These results highlight the potential of multilayer 2D floating-gate devices for implementing energy-efficient neuromorphic hardware and advanced in-memory computing architectures.

Laser Functionalisation of Polymers for Medical Sensing: 3D Subsurface Carbon Structures.

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New carbons, such as graphene, create novel electronics at an ultra-compact scale, replacing metals, silicon and semiconductors, but remain disadvantaged by complex, toxic manufacturing methods, requiring process liquids/gases, clean rooms and controlled atmospheres. We demonstrate a direct write laser (DLW) process to create conducting carbon tracks inside the volume of transparent flexible polymers, to detect spatial variations in temperature and strain, and other chemical and/or physical parameters. The carbon layer is protected within the polymer, ideal for MedTech sensors such as smart polymer skins for monitoring physiological parameters; smart dressings for wound healing; smart catheters or flexible probes for memristor applications in neurosurgery. Laser parameters (pulse energy, pulse duration, rep rate, polarization and scan speed) control carbon quality (amorphous, crystalline), without need for clean room or controlled atmospheres.

Our innovation involves creating three-dimensional graphitic structures within the polymer bulk, by holographic inscription, advancing beyond the highly investigated area of surface modification. We create sub surface vias and layers of carbon, forming resistive, piezoelectric and capacitive structures at dimensions approaching the writing wavelength of ~1 micron. Our prior work, demonstrated DLW vias to connect nanowires and micro-LEDs, illustrating electrical connection of single nano-objects embedded inside a protective solid (1, 2). Recently, we have inscribed subsurface structures below the surface of 125µm Kapton, of dimensions 10µm wide, and resistance of 300Ω, and demonstrated piezoresistive strain gauge performance with gauge factors up to 200.

Here, we compare the performance of a new class of portable, small footprint, low energy ultrafast ytterbium fibre lasers, designed for multi-photon spectroscopy, at 1030/1040nm, with a 1kHz, 180fs, 775nm (Clark-MXR) Ti:Sapphire laser source to create carbon structures on micron scale inside polyimide films (Kapton-H), 120µm thick (3).

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Electrically Conductive Adhesives Based On Nanomaterials For Effective And Sustainable Joule CFRPs Bonding And Selective Debonding

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Growing demand for lightweight structures and reduced CO_2 emissions is driving rapid expansion in the use of carbon-fibre-reinforced polymers (CFRPs). Traditionally, reliable bonding between similar and dissimilar materials (metals, CFRPs, etc.) relies on highly crosslinked thermoset structural epoxies, requiring energy-intensive autoclave curing.

Electrically conductive epoxy nanocomposites filled with carbon nanomaterials offer a promising out-of-autoclave (OoA) alternative as they can be effectively used as Joule adhesives. These nanocomposites can convert electrical energy into heat through Joule heating of the electrically conductive, percolating network of nanoparticles in the matrix, leading to effective and complete curing of the bonding areas, hence, efficiently bonding complex geometries while preserving adherend integrity and functionality.

These bonded joints can also be reversibly Joule debonded, allowing for easy deconstruction of the joints for the components reuse, supporting circularity in composite manufacturing.

However, the intrinsic brittleness of structural epoxies limits the joint's toughness, urging for the development of both conductive and toughened nanocomposites which can be used as Joule adhesives. This project studies the influence of adding toughening agents on the electrical conductivity, thermal and mechanical behaviour, and Joule heating performance of epoxy/CNT/GNP nanocomposites, and its effect on their performance as Joule adhesives for adherend bonding and selective debonding.

Advancing the Thermal Treatment of Radioactive Graphite Waste

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The UK has accumulated approximately 100,000 tonnes of irradiated nuclear graphite, mainly from Magnox and AGR nuclear reactors where it is used as a neutron moderator. Current UK policy is to dispose of the graphite within a geological disposal facility (GDF) which is both non-existent and costly. An alternative to this baseline strategy is the gasification of nuclear graphite into $CO2$ via thermal oxidation, followed by off-gas treatment and final disposal in a carbon capture and storage (CCS) scheme. This disposal method requires significantly less time and capital compared to the baseline approach.

Oxidation of virgin samples will initially be performed at lab scale before eventually working up to larger scale (kilogram). Oxidation parameters such as temperature, oxidant, particulate size, etc will be varied and the effect of this on the oxidation behaviour will be analysed. The off-gas composition will be determined using a quantitative gas analyser (QGA) to investigate oxidation reaction mechanisms and to ascertain if any down-stream gas treatment is necessary. These experimental techniques can then be applied to active samples to assess how neutron irradiation affects the oxidation behaviour. Finally, using previous experimental work and a cost analysis, the viability of graphite gasification on an industrial scale will be examined.

Liquid-Liquid Interfacial Assembly of Liquid-Exfoliated Nanosheets

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Solution-processed 2D nanomaterials have garnered wide interest in printed device research due to attractive functional properties and potential for low-cost commercialisation. Although a range of functional materials have been developed, printed networks remain challenging to understand and optimise. Achieving highly aligned and conductive films is viable at the liquid-liquid interface using modified Langmuir deposition method, particularly for electrochemically-exfoliated semiconducting nanosheets.[1] However, these exfoliation processes typically result in unintentionally heavily-doped films which limits performance for some applications. Liquid-phase exfoliation serves as a versatile alternative to electrochemical exfoliation, which has not been explored extensively in conjunction with liquid-liquid interfacial assembly. This current work demonstrates a simplified method for producing very thin, conductive films via liquid-phase exfoliation and multi-layer deposition. Furthermore, we extend this to large area film deposition for thermoelectric measurements. This research aims to establish a platform to extract electrical transport characteristics of solution-processed networks.

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Uniformly Coated SiO_2-Pyrolytic Carbon Core-Shell Particles

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Pyrolytic carbon (PyC) is a promising functional coating for tribological applications owing to its low friction, wear resistance, chemical stability, and mechanical robustness. However, if coated surfaces are to benefit from such properties the coatings should be highly uniform and reproducible, as variations in coating thickness, surface morphology, microstructure, and coating integrity can significantly influence their performance. This uniformity is not trivial achieve over a spherical surface, such as for silica particles. [1-2]

The fabrication of uniformly coated particulate substrates remains challenging using conventional CVD furnaces. Static batch processing often leads to non-uniform precursor accessibility, inconsistent particle exposure, and particle-to-particle variations in coating thickness. These limitations reduce process reproducibility, hinder systematic optimization, and complicate the scale-up of the coating process. [1, 3]

To overcome these challenges, a novel rotary low-pressure CVD reactor has been developed for the homogenous deposition of PyC on particles. By providing controlled movement of the particles throughout the deposition process, the reactor promotes homogeneous exposure of all particle surfaces to the reactive precursor atmosphere, resulting in uniform coatings. The system further has been designed to allow the use of liquid carbon precursors. [3]

The developed reactor establishes a reproducible and scalable platform for the controlled deposition of PyC on particulate substrates. By improving coating uniformity and reducing process variability, it enables systematic optimization of deposition conditions and provides a foundation for studying the relationship between CVD process parameters, PyC coating characteristics, and functional performance. The presented concept offers a pathway toward scalable manufacturing of uniformly coated particles for future tribological and surface engineering applications. [1-3]

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