HOME PAGE BIOLOGY CHEMISTRY AND PHYSICS MEDICINE SPACE TECHNOLOGY

CONTACT US

Unlocking magnetic properties for future faster, low-energy spintronics

July 8, 2019 in Technology and Engineering 0

Australian collaboration combines theory, experimental expertise: Spintronic applications promise faster, more efficient computing; new magnetic properties of 2D Fe3GeTe2 (FGT) discovered

Credit: FLEET

A theoretical-experimental collaboration across two FLEET nodes has discovered new magnetic properties within 2D structures, with exciting potential for researchers in the emerging field of 'spintronics'.

Spintronic devices use a quantum property known as 'spin', in addition to the electronic charge of conventional electronics.

hetero-structures comprising several layers of novel, 2D materials.

The latest results show that vdW spintronics could provide devices with more functionality, comparing with the traditional spintronic approaches. Further research could generate devices with significant industrial applications.

BACKGROUND

Two-dimensional (2D) ferromagnetic van-der-Waals (vdW) materials have recently emerged as effective building blocks for a new generation of 'spintronic' devices.

When layered with non-magnetic vdW materials, such as graphene and/or topological insulators, vdW hetero-structures can be assembled to provide otherwise unattainable device structures and functionalities.

“We discovered a previously unseen mode of giant magneto-resistance (GMR) in the material, says FLEET PhD and study co-author Sultan Albarakati.

Unlike the conventional, previously-known two GMR states (ie, high resistance and low resistance) that occur in thin-film hetero-structures, the researchers also measured antisymmetric GMR with an additional, distinct intermediate resistance state.

“This reveals that vdW ferromagnetic hetero-structures exhibit substantially different properties from similar structures,” says Sultan.

This surprising result is contrary to previously held beliefs regarding GMR. It is suggestive of different underlying physical mechanisms in vdW hetero-structures, with potential for improved magnetic information storage.

Theoretical calculations indicate that the three levels of resistance are the result of spin-momentum-locking induced spin-polarised current at the graphite/FGT interface.

“This work has significant interest for researchers in 2D materials, spintronics, and magnetism,” says co-author FLEET PhD Cheng Tan. “It means that ‘traditional’ tunnelling magnetoresistance devices, spin-orbit torque devices and spin transistors may reward re-investigated using similar vdW hetero-structures to reveal similarly surprising characteristics.”

###

THE STUDY

As well as support by the Australian Research Council, the authors acknowledge the support of the National Key Research and Development Program (China) and the Institute for Information & Communications Technology Promotion (South Korea).

COLLABORATION

The experiment's detailed electron transport measurements were performed by a collaboration of researchers led by FLEET CI Prof Lan Wang (RMIT) and FLEET Deputy Director Prof Alex Hamilton (UNSW), using hetero-structures and devices fabricated by Prof Wang's team at RMIT.

Theoretical studies were led by FLEET CI Dr Dimi Culcer (UNSW), while data analysis was undertaken by teams comprising both RMIT and UNSW researchers.

Electronic band structure calculations were led by Yunjun Zhao at the South China University of Technology (China).

NANO-FABRICATION AT FLEET

VdW hetero-structures are used to study the properties of novel materials at FLEET, an Australian Research Council Centre of Excellence.

The Centre for Future Low-Energy Electronics Technologies (FLEET) is a collaboration of over a hundred researchers, seeking to develop ultra-low energy electronics to face the challenge of energy use in computation, which already consumes 8% of global electricity, and is doubling each decade.

FLEET's research sits at the very boundary of what is possible in condensed-matter physics. At the nano scale, nanofabrication of functioning devices will be key to the Centre's success.

Specialised techniques needed to integrate novel atomically-thin, two-dimensional (2D) materials into high-quality, high-performance nano-devices are coordinated within the Centre's Enabling technology B, led by RMIT's Lan Wang.

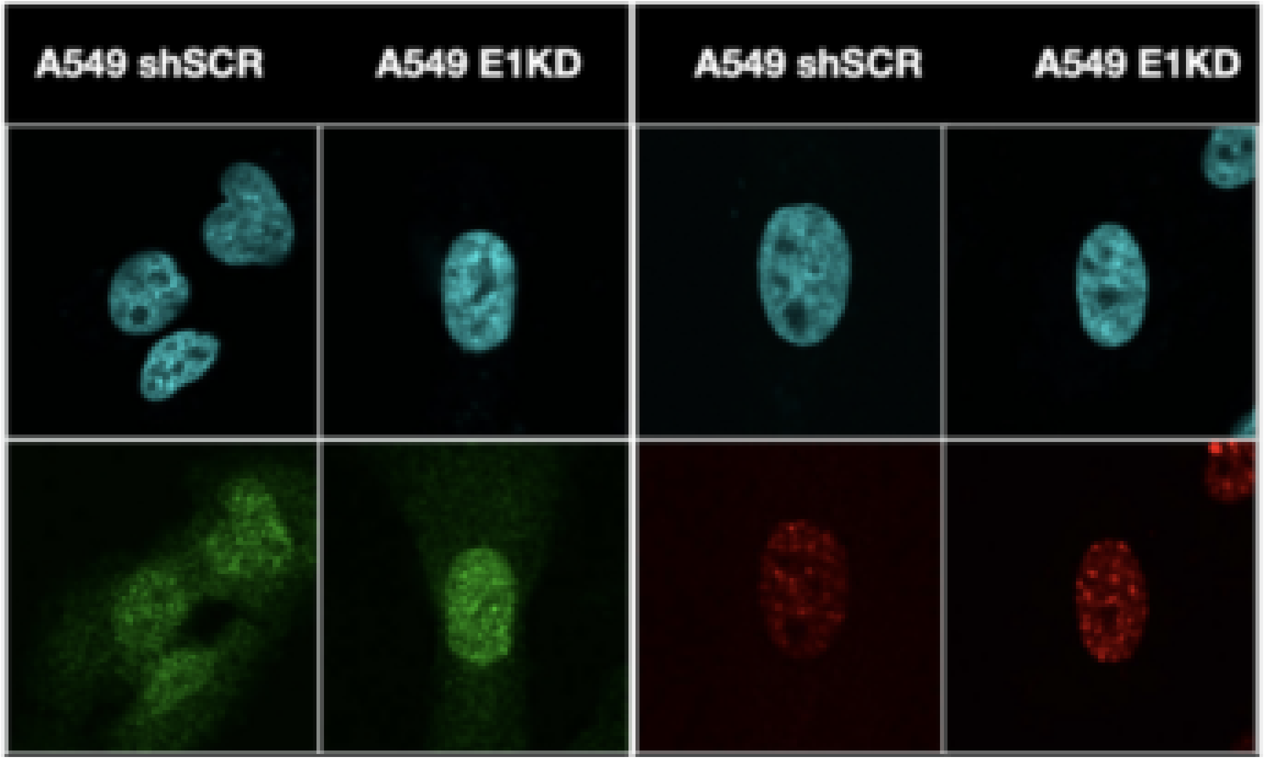
This collaboration between FLEET's UNSW and RMIT teams is typical of the Centre's nano-device research, which links many of FLEET's groups and nodes. Some groups bring expertise in device fabrication, while other groups are strong in device characterisation. Such teamwork, fundamental to modern science, is expedited by the Australian Research Council Centre of Excellence system.

Media Contact
Errol Hunt
media@fleet.org.au

Related Journal Article

http://dx.doi.org/10.1126/sciadv.aaw0409

Tags: Electrical Engineering/Electronics Materials Nanotechnology/Micromachines Technology/Engineering/Computer Science



Dual action: RNA binding protein also binds DNA and acts as a damage sensor across the genome 01

234 SHARES

02 'Stealth transmission' fuels fast spread of coronavirus outbreak

219 SHARES

03 Wiggling worms suggest link between vitamin B12 and Alzheimer's

144 SHARES

04 Metabolism changes with age, just not when you might think

138 SHARES

05 Chinese case study suggests COVID-19 is not transmitted from pregnant mothers to newborns

260 SHARES

Do passengers prefer autonomous vehicles driven like machines or like humans?

July 8, 2019 in **Technology and Engineering** 0

Research finds that 'peeking round' corners provides answers

Passenger and pedestrian confidence and acceptance will be key to the future and development of autonomous vehicles so researchers at WMG at the University of Warwick have just conducted and reported an experiment to see which autonomous vehicles driving style engendered the highest levels of confidence among autonomous vehicles passengers – driving with full machine efficiency, or driving in a way that emulates average human driving. The surprising result was that neither was optimal but that a blend of both might be best.

The researchers took 43 volunteers into a large warehouse designed to resemble a pedestrianised area in a town centre with a series of routes that included a range of junctions. Half were given 4 journeys around the route in an autonomous vehicle driving with full machine efficiency using all its capabilities to drive in as safe and efficient manner as possible while the others were given 4 journeys around the route in autonomous vehicles that tried to closely emulate average human

The overall result was that there was only a marginal difference in trust between the two driving methods. The efficient machine method was slightly favoured but even that small gap between the two driving styles narrowed over the four runs. What was noticeable for both the "machine" and "human" driving styles is that confidence in both grew with each new round suggesting that simple familiarity and growing accustomed to the experience will be one of the most effective ways of quickly building trust and acceptance of autonomous vehicles once their use becomes more widespread.

Mean scores of trust	Human	Machine
First Run	59.30	63.19
Second Run	59.55	66.33
Third Run	65.85	68.29
Fourth Run	67.20	69.38

was a particularly steep change upwards in the scores between runs 2 and 3. The passengers in the experiment also acknowledged that future generations may be more comfortable with AVs and its features, as they learn to live with the new technology."

The researchers also asked the participants to give some narrative about their experience and this showed that there were advantages on both modes of driving that may therefore need to be blended together in any future final package. The researchers' literature review and warehouse experiment made clear that there re were two particularly clear lessons to be learned:

Smooth speed change – Past studies had already shown that Human drivers' tendency is to break most at the start of any manoeuvre that requires deceleration whilst the totally automated driving programmes applied speed changes more gradually and efficiently. Human passengers preferred the comfort of the smoother changes of acceleration and deceleration provided by the machine driving methods.

turn….there were moments where it was accelerating around corners, I think it catches you unaware".

WMG's Dr Luis Oliveira said "this shows that the challenge is that the speed and trajectory of autonomous vehicles should be finely controlled, but at the same time the vehicle should be assertive to provide the benefits of automated driving.

However it was the AVs' behaviours at junctions in the WMG University of Warwick warehouse test that produced the most diverse and surprising reactions.

The machine driven AVs were left to make use of all of their sensors and ability to communicate with vehicles that may out of line of sight to decide whether to enter a junction. If their sensors said it was safe and their communications with other vehicles indicated no approaching threats they would simply enter the junction without stopping. If however they detected a vehicle that they believed should have right of way – even if it was not yet visible to the human passenger they would stop and let that vehicle pass. In contrast The AV's emulating human driving would always stop at a junction and would even edge into the junction as if the peek at what the oncoming traffic might be.

The reactions to those two different approaches were very varied and surprising.

Some liked the human approach with one saying that the AV was "…probably trying to inspire confidence in the passenger, I'm guessing, in terms of like the way it behaved, kind of quite similar to a human, it's only ever going to inspire confidence I think it's because that's what we're used to".

Some also liked the machine driving approach of stopping at junctions even though there was no visible issue but because it was in communication with another out of sight vehicle that it

Some perceived problems with the machine approach of just entering the junction if it believed it to be clear to do so with one saying that they were concerned about vulnerable road users. "..such as pedestrians or cyclists that could have been there that don't communicate with the pod. That may be a safer way of doing it rather than flying around the corner".

However others were greatly surprised at the "human" driving method AV stopping at every junction as they saw it not just as waste of the machines capabilities to scan and communicate ahead to understand traffic. They were frustrated that the vehicle was not "more assertive" One passenger saying "sometimes I didn't expect it to stop, because I thought the other pod was a bit further away but then it did, so I guess it's cautious…if I was driving I'd probably have gone". Another passenger said "If I was in an autonomous pod with sensors giving a 360-degree view at all times, I'd expect the vehicle to instantaneously know whether it was safe or not, and not need to edge out".

Despite this seeming mass of contradictions in views about how AVs should handle junctions the research team do think there are valuable lessons to be learned even here. In particular:

- There is clearly a need to give the general public the details of the driving systems, for example, the recent technological features such as vehicle to vehicle communication
- For passengers in a vehicle consideration should be given to having a display and/or audio information that shares some of the information the vehicle is using so users can understand that the system is aware of hazards beyond the field of view
- There may be some merit in presenting the full benefits of the most efficient methods of machine based driving progressively when mass use is first introduced, so that passengers can build confidence over time

###

Note for editors: The full list of authors on the paper is Luis Oliveira (corresponding authour), Christopher G. Burns, and Professor Stewart Birrell (all of WMG at the University of Warwick at time of publication of the journal article and Karl Proctor of Jaguar Land Rover)

For further details please contact:

Luke Walton, International Press Manager

University of Warwick

L.Walton.1@warwick.ac.uk

Peter Dunn, Director of Press and Media Relations

University of Warwick

Tel office: 024 76523708 UK +44 (0)24 76523708 International

Mobile/Cell: 07767 655860 UK +44 (0)7767 655860 International

Email p.j.dunn@warwick.ac.uk

or

Lisa Harding, Head of Marketing and Communications, WMG,

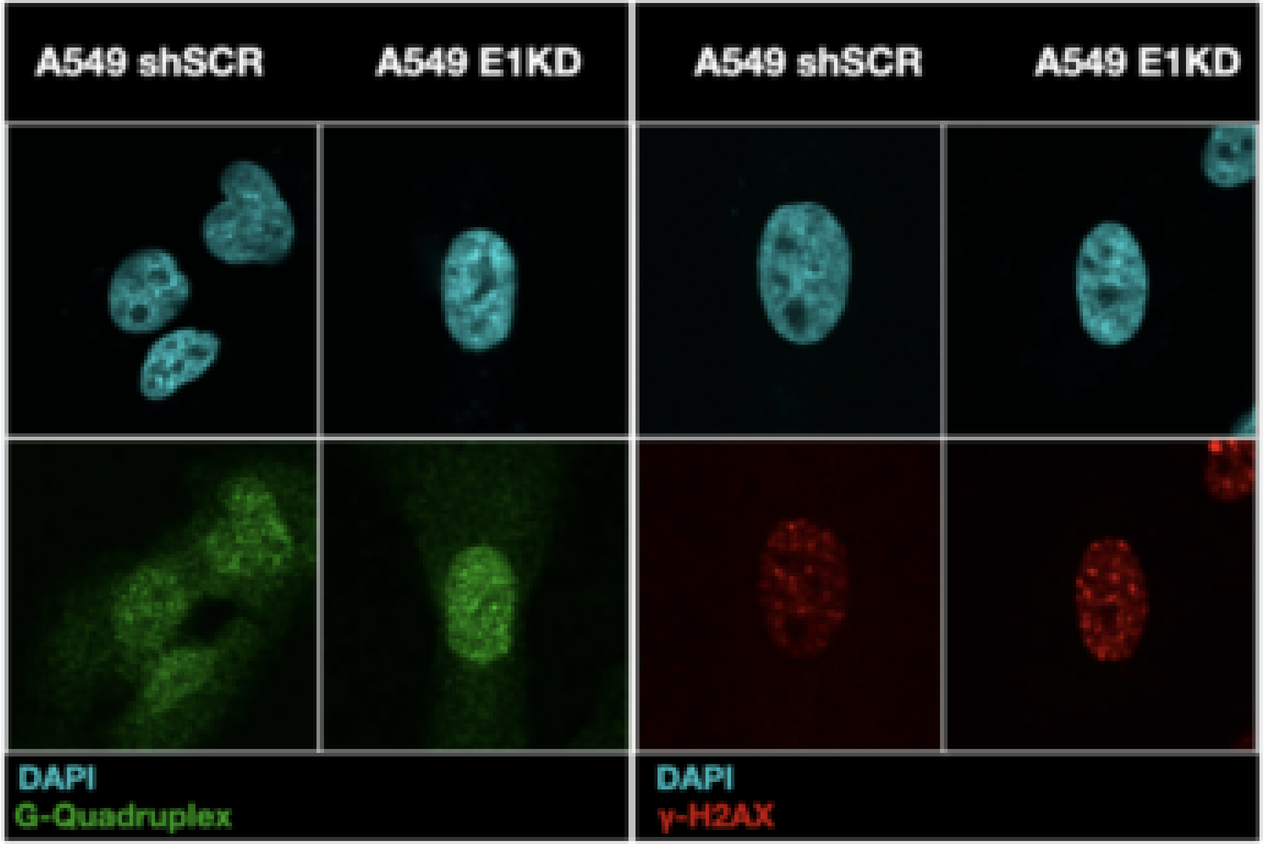
University of Warwick Tel: 024 76 524721 or 07824 540845

email L.Barwick@warwick.ac.uk

Media Contact
Luke Walton
L.Walton.1@warwick.ac.uk

Related Journal Article

https://warwick.ac.uk/newsandevents/pressreleases/do_passengers_prefer
http://dx.doi.org/10.3390/info10060219



Dual action: RNA binding protein also binds DNA and acts as a damage sensor across the genome

01

234 SHARES

‘Stealth transmission’ fuels fast spread of coronavirus outbreak

We bring you the latest science news from best research centers and universities around the world. Check our website.

Latest NEWS

- What level of antibody response protects against COVID-19 death?
- Changes in older adults' life space during lung cancer treatment
- "Once-in-a generation" tardigrade fossil discovery reveals new species in 16-million-year-old amber

Subscribe to Blog via Email

Enter your email address to subscribe to this blog and receive notifications of new posts by email.

Join 178 other subscribers

Email Address

Subscribe