research highlights

SPIN CALORITRONICS

Bulk isn't everything

Phys. Rev. Lett. **118,** 057201 (2017)

Thermal gradients along a material may imply the generation of a spin current via the spin Seebeck effect. In magnets, the bulk nature of this effect has been explained based on how thermal gradients affect the characteristic spectrum of magnons. In metal/magnet bilayers, a different mechanism has been put forward, driven by mutual out-of-equilibrium conditions for electron and magnon baths present on the different sides of the interface. However, no experimental report has disentangled the bulk and interfacial mechanisms yet.

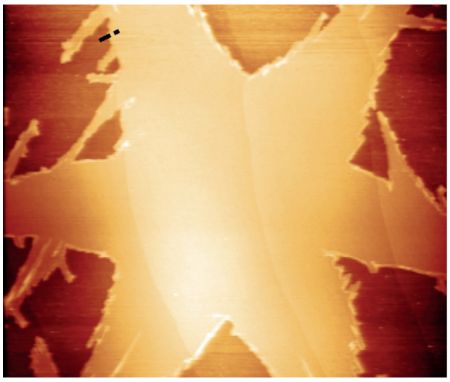
Now, Kimling *et al.* observe the development of a thermally-induced spin accumulation at the interface between metallic Au or Cu and magnetic $Y_3Fe_5O_{12}$ on a timescale of a few picoseconds. The researchers use pump–probe magneto-optical Kerr spectroscopy, rather than more common techniques based on the inverse spin Hall effect — which are subject to detect spurious signals and have a limited time resolution. The choice of Au or Cu ensures long spin-relaxation times as well as weak electron–phonon coupling, leading to high temperature values for the electron bath under laser illumination.

The researchers deduce that the short timescale is only compatible with an interfacial mechanism. This is confirmed by the proposed model, able to reproduce the experimental data well for magnetic layers with different thickness values. *GP*

TRANSITION METAL DICHALCOGENIDES

A topological phase in 2D

2D Mater. **4,** 021008 (2017)



IOP

The predominantly semiconducting nature of transition metal dichalcogenides (TMDs) favourably contrasts them with gapless graphene for several electronic applications. Contingent upon the atomic arrangement of TMD layers, a number of structural phases with diverse electronic properties may exist. Recently, it has been theoretically suggested that in the case of WTe_2, topological electronic states can be found in the distorted octahedral 1T′ phase. However, this polymorph is not energetically favourable and is therefore hard to study experimentally. Naylor *et al.* now report the growth and characterization of a monolayer WTe_2, a unique TMD material with a 1T′ ground state.

Due to rapid degradation of 1T′ WTe_2 flakes grown by chemical vapour deposition (CVD), the researchers use a graphene overlayer to protect the material from exposure to air. The results of Raman mapping and X-ray photoelectron spectroscopy characterization confirm the 1T′ phase in monolayer and few-layer WTe_2 flakes. The investigation of their electronic properties suggests metallic conduction at 2 K. Moreover, the magnetoresistance data reveal a weak antilocalization feature, which is commonly observed in topological insulators and could be indicative of the presence of topological states in 1T′ WTe_2 monolayers. Further improvement of the growth protocol is required to increase the surface coverage of the CVD-grown WTe_2 film for extended characterization of the electronic properties of the material. *OB*

NANOTEXTILES

A weave of polymers

Nat. Commun. **8,** 14442 (2017)

A current challenge in polymer chemistry is the bottom-up synthesis of textile structures in which one-dimensional fibres are interwoven to form a two-dimensional sheet. Now, Wang *et al.* report a self-standing textile made of polymer fibres about 200 nm long.

Wang *et al.* first make a template layered structure comprising planar metal–organic frameworks of square arrays with copper(I) atoms at the vertices and organic linkers with a central benzene ring at the edges. The benzene rings are also shared by two other groups pointing towards the centre of the squares and ending with a reactive alkyne moiety. The structure alternates these layers with sacrificial ones being analogously constructed — the only difference being that the alkynes are replaced by inert methyls.

To create the interwoven fibres, Wang *et al.* link adjacent alkynes by an oxidative acetylene coupling reaction. Steric arguments dictate that, out of the four alkynes pointing towards the inside of the square, only those attached to parallel linkers can react with each other, and no reaction between moieties from different layers can occur. Once one reaction has taken place, the second one between the unreacted pair of alkynes can only occur either above or below the plane of the already-coupled alkynes. Extending this chemistry to the entire framework creates randomly interwoven polymeric fibres. Finally, the copper atoms and the sacrificial layer are easily removed to isolate a self-standing textile. *AM*

BIO-INSPIRED PHOTONICS

Cellulose reflects left and right

Adv. Mater. **29,** 1603560 (2017)

Cellulose nanocrystal films only selectively reflect left circularly polarized (LCP) light, while being transparent to right circularly polarized (RCP) light. This effect is due to the particular way in which chiral cellulose nanorods self-assemble. Now, taking inspiration from the cuticle of the beetle *Plusiotis resplendens*, Fernandes *et al.* have designed a new photonic structure in which these chiral cellulose nanocrystals are capable of reflecting both LCP and RCP light.

This photonic structure is made by sandwiching an anisotropic nematic liquid crystal layer made of 4-cyano-4′-pentylbiphenyl into a microgap between two left-handed cholesteric nanocellulose domains with similar pitches. The nematic layer acts as a half-wave retardation plate, transforming RCP into LCP light and vice versa. In this way, the RCP light can also be reflected back efficiently.

The researchers also show that, due to the reversible transition of the anisotropic liquid crystal layer from nematic to isotropic, the RCP light reflection can be controlled by varying the temperature or applying an electric field.

For instance, at a temperature above the nematic-to-isotropic transition temperature, all the RCP light is transmitted (colourless reflection) due to the loss of the retardation plate effect, while the LCP light is still reflected, but with a higher wavelength, owing to the decrease of the material refractive index and the increase of the pitch of the cholesteric chiral phases. *WS*

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