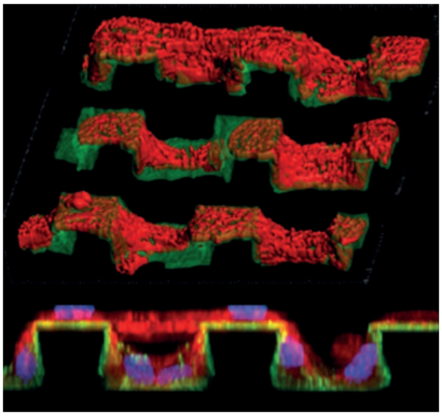
PROTEIN PATTERNING

Complex cues

Nature Methods **12,** 134–136 (2015)



NATURE PUBLISHING GROUP

The behaviour and organization of cells can be regulated by appropriate cues on cell-culture substrates. For example, neural cells have been aligned by depositing them on flat substrates coated with gradients of cell-adhesive molecules, and tissues can be grown asymmetrically on substrates by patterning (typically, with soft lithography) appropriate combinations of physical and chemical patterns. However, independent control of topography and chemistry on structured (rough) substrates has been difficult to achieve. Now, Adam Feinberg and colleagues report a method for the transfer of defined patterns of proteins to topographically complex surfaces. First, a topographically patterned substrate is brought into contact with glass coverslips spin-coated with a thermally sensitive polymer and patterned (through microcontact printing) with a protein, and then the system is cooled down. As the polymer swells and dissolves on reaching its lower critical solution temperature, hydrophobic interactions force the protein to form a conformal ~5-nm-thick layer on the patterned surface. The researchers used the method to characterize the responses of cardiac cells to orthogonal topographic and chemical cues. *PP*

FERROELECTRIC DOMAINS

Swift walls

Adv. Mater. http://doi.org/f2x83m (2015)

Ferroelectric materials consist of domains of aligned electric dipoles, separated by domain walls. When an electric field is applied the various domains can reorient, leading to a switching in net polarization of the bulk material. This process requires the nucleation and growth of the domain walls however, associated with which will be a time delay. Given that ferroelectric materials are being utilized in applications that rely on this switching process, such as fast, high-density, non-volatile memory, it is vital that changes in domain structure occur quickly, necessitating fast domain wall kinetics. Er-Jia Guo and co-workers now demonstrate that a small in-plane epitaxial strain is effective at enhancing domain wall velocity; approximately 0.1% in-plane strain in ferroelectric $PbZr_{0.2}Ti_{0.8}O_3$ grown on an $La_{0.7}Sr_{0.3}MnO_3$ substrate can drive an order of magnitude increase in the velocity of 180° domain walls. This study demonstrates that by understanding and controlling external parameters it may be possible to optimize fast switching between polarization states in ferroelectrics. *JP*

QUANTUM OPTICS

The dark exciton as a qubit

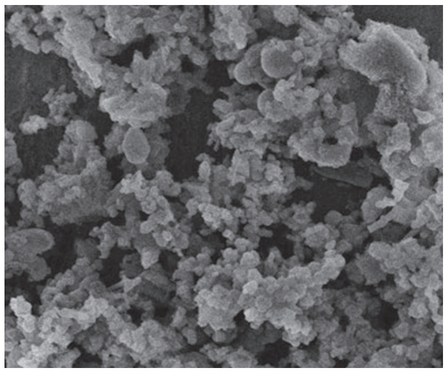
Phys. Rev. X **5,** 011009 (2015)

Optical and deterministic control of qubits is at the heart of successful quantum information schemes. In this context, the spin of carriers in semiconductor quantum dots has attracted much attention. Now, Ido Schwartz and co-workers have demonstrated the suitability of the dark exciton (electron–hole pair with parallel spins) for quantum applications. Following a pump–probe experiment, they not only show that deterministic initialization is possible but they also extract the lower bound values for its lifetime (1 μsec) and coherence time (0.1 μsec). Furthermore, the researchers managed to rotate the dark exciton eigenstate around the right-hand circular polarization direction on the Bloch sphere. Given its much longer coherence time with respect to other charge carriers in quantum dots, as well as the simplicity in initializing and resetting its value, the dark exciton is shown to have potential as a solid-state spin qubit. *MM*

LITHIUM-ION BATTERIES

Simply silicon

Angew. Chem. Int. Ed. http://doi.org/f2zgbh (2015)



WILEY

The use of silicon nanomaterials in anodes of rechargeable lithium-ion batteries has resulted in a keen interest in the development of new synthetic routes to these materials. Now, Ning Lin *et al.* report the preparation of polycrystalline nanosized silicon from the reduction of $SiCl_4$ in the presence of metallic Mg and $AlCl_3$ at 200 °C inside a stainless steel autoclave. The resultant nanoparticles are shown to have a high reversible capacity of 3,083 mAh g^{-1} at 1.2 A g^{-1} after 50 cycles when used as anode materials and good long-term cycling stability. The researchers investigate the mechanism of the reduction reaction and reveal that the molten salt $AlCl_3$ is reduced by metallic Mg to form metallic Al, which then proceeds to reduce $SiCl_4$ to Si. The silicon nanoparticles range in size from several tens of nanometres to about 100 nm. Furthermore, the method is high yielding (over 80%) and uses relatively mild reaction conditions. *AS*

QUANTUM MECHANICS

Entangled spins

Nature Phys. http://doi.org/zxx (2015)

Two particles are entangled when their quantum state cannot be described independently. Such interdependence can be exploited for computing, communication or cryptography purposes. Photons are commonly used for practical applications mainly because they can be easily manipulated, although solid-state components would be desirable for the development of quantum computers. Now, Sven Sahling *et al.* demonstrate the entanglement of unpaired spins separated by several hundred ångströms in bulk $Sr_{14}Cu_{24}O_{41}$. This layered material is formed by dimerized spin chains. The chain lattice structure — formed by two sublattices — causes a modulated potential that gives rise to unpaired spins at well-defined positions within a chain. Below 2.1 K the spins become entangled through antiferromagnetic interactions, which is reflected in the macroscopic properties, such as the magnetization and the specific heat, of the bulk material. The experimental results suggest that the dimers could potentially be used as data buses for the transmission of quantum information over mesoscopic distances. *DC*

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