waves in metals[2]. Apart from its ability to capture snapshots of light in the form of surface plasmons, TR-PEEM has proved valuable in measuring electron flow and charge transfer processes in semiconductors[6,7].

Man *et al.* investigate a sample consisting of an InSe flake held by van der Waals forces on a GaAs substrate[1]. With IR femtosecond laser pulses they excite electron-hole pairs across the band gaps of both GaAs and InSe. Once generated, the energy and spatial distribution of electrons in the conduction bands of both materials are monitored by further excitation with a UV femtosecond pulse, which emits the electrons into vacuum (Fig. 1). Because the photoelectron kinetic energy is determined by the electron energy in the conduction band, the work function of the sample, and the photon energy, the spatially resolved photoelectron energy analysis provides images of electron energy relaxation in space and time within the semiconductor heterostructure. The ultrafast microscopy measurements reveal that electrons relax differently in regions of InSe crystal of different thickness. The type II band alignment between GaAs and InSe is such that electrons excited into the conduction band of InSe flow into the lower potential GaAs substrate. Thus, the movies recorded by Man *et al.* demonstrate the evolution of the primary photoelectron distribution through the combined effects of electron–phonon interaction, inhomogeneous electron potentials, and diffusion with the process terminating as the flow of charge builds up retarding potentials.

The observed dynamical processes continuously occur in semiconductor solar cells and are to a large extent well understood. The power of the described technique, however, will truly come to the fore in investigation of novel materials and their quantum processes where the physics of light conversion into the coherent optical modes of matter, excitons and plasmons[8] is not well established. For example, in perovskite solar cells[9] or in plasmonically enhanced photocatalysis[10], the ultrafast nanoscale imaging can reveal the fundamental interactions for more effective solar energy harvesting, improved device efficiencies and novel device concepts. ❐

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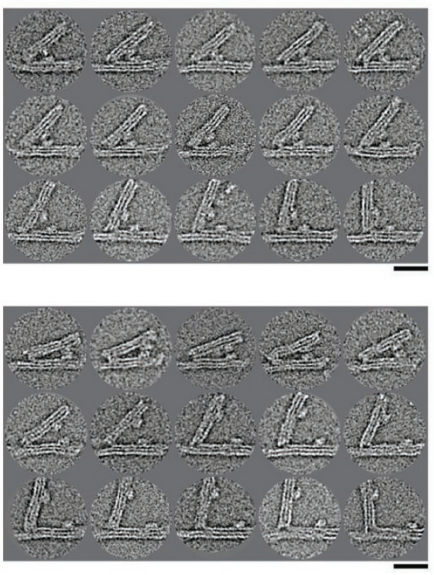
DNA NANOTECHNOLOGY

A nucleosome clamp

In eukaryotes, compaction of genomic DNA into dense chromosomes is the result of multiple levels of structural organization that are crucial for genome regulation and is orchestrated around the nucleosome basic units. Nucleosomes are made of 147 DNA bases tightly wrapped around an octameric protein core, composed of two copies of the histone proteins H2A, H2B, H3 and H4. Nucleosome arrays are arranged in a beads-on-a-string fashion, and fold into chromatin fibres, which then assemble into higher order structures. Finely tuned interaction forces between neighbouring nucleosomes drive chromatin formation and modulate the subsequent structural changes. While previous chromatin mechanical pulling experiments have measured the nucleosome interaction strengths, the details of the relative interaction potential, which would provide a better insight into the dynamic properties of chromatin, were missing. Now, J. J. Funke *et al.* present a molecular force spectrometer that can be used to access this information (*Sci. Adv.* **2,** e1600974; 2016). The device consists of two DNA origami beams connected in a V shape, free to rotate around the hinge region under the attraction of two nucleosomes mounted on each beam. The origami platform allows very tight control over the relative nucleosome position and orientation, which is fundamental to unambiguously derive the interaction potential. Similarly to what happens in more traditional force spectroscopy experiments, the sample, in this case the origami device, can adopt a wide variety of conformations, characterized by specific aperture angles — the arms of the spectrometer are pulled together to different degrees depending on the extent of nucleosome attraction. Using single particle imaging with transmission electron microscopy (TEM) the authors count the number of spectrometers displaying a certain opening angle and reconstruct the free energy landscape for the nucleosome–nucleosome interaction based on the statistical distribution of the observed conformations. Their results suggest the existence of long-range weak nucleosome–nucleosome interactions and support the existence of a compliant, fluid-like chromatin state, in line with recent hypotheses and in sharp contrast with the classical model of a rigidly structured, linear chromatin. The TEM micrographs in the picture show a set of representative conformations of the spectrometers with nucleosome pairs anchored at 15 nm (top) and 30 nm (bottom) from the hinge (scale bars, 30 nm).



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