Plenary lectures

PL-1 Serial crystallography with X-ray free-electron laser pulses

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The pulses from X-ray free-electron lasers are a billion times brighter than the brightest synchrotron beams available today. When focused to micron dimensions, such a pulse destroys any material, but the pulse terminates before significant atomic motion can take place. This mode of "diffraction before destruction" yields structural information at resolutions better than 2 Angstrom, from proteins that cannot be grown into large enough crystals or are too radiation sensitive for high-resolution crystallography. This has opened up a new methodology of serial femtosecond crystallography that yields radiation damage-free structures without the need for cryogenic cooling of the sample. The method has begun to yield new structures and has the potential to increase the rate at which structures can be solved. Ultrafast pump-probe studies of photoinduced dynamics in proteins or other materials can also be studied. Irreversible reactions can be studied, synchronised with the short pulses, with new sample being constantly replenished. We have yet to reach the limit of the smallest samples that can be studied this way, and many innovations indicate the feasibility of single molecule diffractive imaging.

Keywords: X-ray free-electron lasers, serial femtosecond crystallography

PL-2 Graphene future emerging technology

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Disruptive technologies are usually characterised by universal, versatile applications, which change many aspects of our life simultaneously, penetrating every corner of our existence. In order to become disruptive, a new technology needs to offer not incremental, but dramatic, orders of magnitude improvements. Moreover, the more universal the technology, the better chances it has for broad base success. Does graphene have a chance to become the next disruptive technology? Can graphene be the material of the 21th century? Are the properties of graphene so unique to overshadow the unavoidable inconveniences of switching to a new technology, a process usually accompanied by large R&D and capital investments? In spite of the inherent novelty associated with graphene and the lack of maturity of graphene technology, a roadmap can be envisaged, including short-term milestones, and some medium- to long-term targets, intrinsically less detailed, but potentially even more disruptive. This should guide the transition towards a technological platform underpinned by graphene, with opportunities in many fields and benefits to society.

Keywords: graphene