Brilliant explosions

To the Editor — The levitation of a frog in large magnetic fields, the velocity of sound in Cheddar cheese and the vibration of a ponytail during jogging are just a few of the outrageously funny but perfectly valid scientific problems that have been awarded with an Ig Nobel Prize. The prize, which honours achievements in ten categories including physics, physiology, peace and economics, is awarded annually at Harvard University, highlighting research that should "first make people laugh, and then make them think"[1].

This is exactly what happened in September 2012, when Igor Petrov of SKN Company, Russia, was honoured with the Ig Nobel Peace Prize for using ex-Soviet explosives to produce nanoscale diamond particles[1]. Although it may sound unrealistic, the technology does exist. The diamonds are formed from high-energy explosives such as, for example, a mix of 40% trinitrotoluene and 60% hexogen that detonate in a closed steel chamber filled with an inert gas or water (ice) coolant (Fig. 1). The process was invented in the former USSR in the 1960s by Vycheslav Danilenko and co-workers[2], but remained essentially unknown to the rest of the world until the 1980s. It has been widely adopted since the collapse of the Soviet Union. Today, hundreds of kilograms of such 'detonation nanodiamonds' are manufactured and sold annually across the world.

The choice to award the Ig Nobel Prize to this obscure method of utilizing otherwise obsolete army material is going beyond its peaceful connotation. The key advantage of the method is the uniform size of the detonation nanodiamonds, which is approximately 3–6 nm. Nanodiamonds have recently emerged as a prime platform for many branches of nanoscience and nanotechnology. Their super-hardness and outstanding chemical and radiation resistance motivate the application of nanodiamonds in novel wear-resistant polymers, metal coatings, and as additives in motor oils[3]. On the other hand, even the smallest diamonds host bright, photostable defects (also named colour centres) that emit light on laser excitation[4,5]. One of the defects, the nitrogen-vacancy centre, exhibits an additional remarkable feature — its optical spin can be manipulated using a microwave field and optically read out at room temperature[6,7]. This possibility has ushered the use of nanodiamonds as high-resolution magnetometers and sensors for electric fields[8–10], and nitrogen-vacancy centres have been exploited to perform quantum measurements within living cells[11]. Generally, their biocompatibility and the possibility to chemically functionalize them allows the nanodiamonds to be used as biolabels or biomarkers in the life-science community[12]. Targeted drug-delivery to deliver vaccines and probe biological processes *in vivo* by harnessing the optical, chemical and spin properties of the nanodiamonds may also be possible.

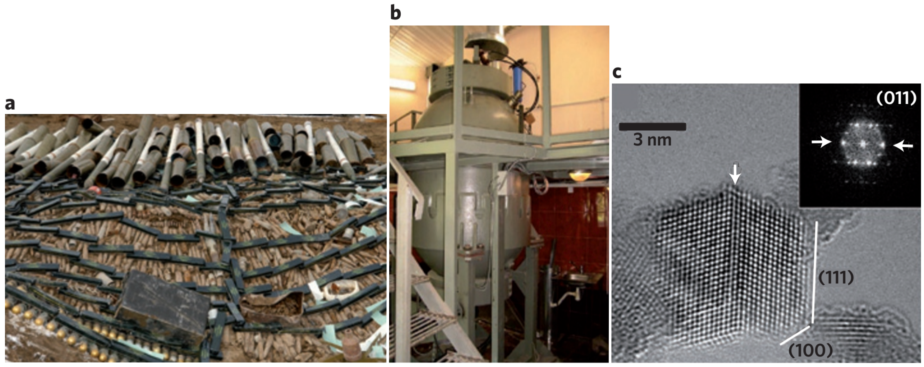

Figure 1 | Converting degraded weaponry to research materials. **a**, Demolition charges consisting of several explosives on top of degraded weaponry scheduled for destruction in the field. **b**, A detonation chamber for the production of nanodiamonds from explosives. **c**, High-resolution transmission electron microscope image of a 6-nm detonation nanodiamond. Images from: **a**, US Air Force/Captain Catie Hague; **b**, Courtesy of V. Dolmatov, Diamond Center, Russia; **c**, ref. 3, © 2012 NPG.

Formidable challenges remain in using individual particles: achieving long coherence times from nitrogen-vacancy centres in nanodiamonds smaller than 10 nm and increasing the photostability of the emitters. Nevertheless, it is clear that nanodiamonds have found an important role in many branches of nanoscience. Now these tiny particles have been recognized by what is perhaps the toughest crowd to impress — the Improbable Research community. So far, only one person (Andre Geim) has won both the Nobel (for experiments on graphene) and the Ig Nobel Prize (for using magnets to levitate a frog). Constant scientific development and increased use in practical applications may eventually help nanodiamonds achieve such a dual distinction. ❐

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