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News and Views
Material witness: Call yourself hard?
PHILIP BALL

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Those girls can flirt and other queer things can do. It's not, these days, a very acceptable mnemonic for remembering Friedrich Mohs' ordering of minerals according to hardness (talc, gypsum, calcite, fluorite, apatite, orthoclase, quartz, topaz, corundum and diamond). But there's no doubt that diamond still ranks highest — 10 on Mohs' ten-point scale.

Knocking diamond off its pedestal has become something of an obsession. The usual justification for this quest is that superhard materials are industrially important for cutting and abrasion, and that even diamond is not perfect in this regard — it can dissolve iron and so is of little use for shaping one of the most widespread industrial materials, steel.

That shortcoming is accommodated by cubic boron nitride — General Electric's Borazon — which ranks second to diamond in hardness and is mass-produced at high pressure and temperature. A material that rivals these two in hardness while being cheaper to make would be a boon to industry and technology, but it is hard to sustain the notion that many of the candidate superhard materials explored so far would indeed be manufacturable at less expense than is required to squeeze graphite.

One has to suspect that the real driver behind attempts to better diamond is the desire to come top: it is the same motivation that impels searches for the strongest, lightest or smartest materials. Most materials engineers acknowledge that, save for a few niche applications, the most useful materials tend to be not those that excel in one particular capacity but those that find the best compromise of several, often competing, properties.

'Superhard' is in any case open to interpretation (V. Brazhkin *et al*. *Nature Mater*. **3**, 576; 2004): high Young's or bulk modulus (resistance to elastic deformation) has a different mechanistic origin from high hardness (resistance to plastic deformation). But because the two are often correlated, the search for superhardness tends to embrace materials with potentially high moduli. That's why, in addition to exploring materials made from light elements that form short, strong covalent bonds — β-C_3N_4 was for several years a promising candidate, and B_6O has comparable hardness to cubic boron nitride — there is also interest in materials with a high density of valence electrons, which makes them resist elastic compression (R. B. Kaner *et al*. *Science* **308**, 1268; 2005).

Now, however, it seems that diamond has been superseded, albeit by simply a variant of its standard crystalline form. Natalia Dubrovinskaia at the University of Bayreuth in Germany and her co-workers report a material they call aggregated diamond nanorods, with a bulk modulus of 491 GPa, compared with diamond's 442 GPa. A standard measurement of microhardness using a diamond tip did not work because the diamond caused no indentation (N. Dubrovinskaia *et al. Appl. Phys. Lett.* **87**, 083106; 2005).

The preparation conditions are more extreme than those needed to make synthetic diamond, however. So this, like most record-breakers, doesn't come without cost.