POSTERMINARIES

Wotta Yotta Atoms

The prefix *nano* is everywhere. This is OK for today but, like Fleetwood Mac, I can't stop thinking about tomorrow. I already have plans to leapfrog the *nano* generation and will ask my university to re-name my post "Professor of *Pico*-Engineering" (or PPE for those who like classical educational allusions). But the next generation of materials practitioners is then in a real fix—the *pico* scale is already of subatomic dimensions, so where do we go from there?

I suggest we learn from the example of the storage media folks and the astronomers: Big is Beautiful. Every generation (where a Moore's Law generation is only a year and a half, of course) brings a doubling of something or other, so new prefixes come into usage fairly frequently. Most of us can remember kHz becoming MHz, smoothly eliding into GHz. We are reasonably happy with talk of *tera*herz or *tera*-bytes and occasionally an enthusiast blows us over with *peta*bytes or *exa*bytes. The visionaries are not content with a mere 10^{18} of anything, so they have coined a whole alphabet of new prefixes to cope with the next decade or so. Following *exa* (the power of 18) is an entire new series of extraordinary little modifiers which start with *zeta* (21) and then go backwards down the alphabet, continuing with *yotta* (24), *xona* (27), *weka* (30), and going on and on (and on). Until I discovered this fascinating list, I was planning to invent my own. I had planned to use *egga* (as in Schwarzenegga), *wotta* (as in wotta lotta) and *plata* (as in chips), but I realize that I am too late, and anyway I would have to change one of them to *guvna*.

Where does this leave the ambitious materials scientist, trying to make a mark in this competitive world? Clearly there is little mileage in trying to go smaller. Perhaps the better route is to make the most of the large numbers of atoms we deal with. This approach turns our usual world on its head, because there is suddenly kudos in working with large numbers of atoms. The laboratory manipulator of a handful of surface atoms can justifiably claim the title atomic engineer, whereas the catalyst developer can upgrade to *mega*-atomic engineer (for each particle!) and *tera*- or *peta*-engineer for a modest spatulaful. The MBE grower, depositing a few micrometers of semiconductor on an eight-inch wafer, becomes at least a *zeta*-atomic engineer, while the humble one who puts the final computer together (weighing several kg) can boast of *yotta*-engineering skills.

Clearly, in this *sorta*-future (10^{42}) there would soon be a fight-back by the now-marginalized atomic engineers.

Just one aspect of this wonderful system for publicizing the work of materials scientists perturbs me: The other, more macroscopic, engineering professions can score even higher than we can. Automobile manufacturers would irritatingly badge themselves as *xona*- or *weka*-engineers (imagine Forsprung durch Weka-technik) and as for civil engineers—a mere bridge would be *vunda*-engineering and a dam might make it to *uda*- or *treda*-engineering (10^{39} atoms, for those of you not following too closely at this stage). Mind you, it is a shame not to use *vunda*; I had hopes for high-pressure scientists to rejoice that their work was *vunda*-bar, but they would need an awfully large sample or an immensely high pressure!

Clearly, in this *sorta*-future (10^{42}) there would soon be a fight-back by the now-marginalized atomic engineers. They could (and probably would) choose to define their work in reciprocal space. After all, many of their most useful thoughts are represented in these alternative three dimensions. The obvious unit is the recigram (reciprocal gram), which restores the STM or AFM scientist at the frontiers of atomic manipulation to the glories of *zeta*-engineering (playing with a whopping 10^{21} recigrams at least), and possibly even *yotta*-engineering (although this is pushing it a bit—hydrogen is only a fraction of a *yotta*-recigram). Under this superior system, computer assemblers are returned to their proper status as mere reciprocal engineers while auto manufacturers are just *micro*-recigram engineers—small stuff, huh?

I'm off to have a cup of coffee, but I can't decide whether to add 5 grams of sugar, 0.2 reci-grams, or a *yotta*-load of molecules. Better still—none of these. I don't want some overpaid surgeon offering me *xona*-atomic liposuction.

PETER GOODHEW

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