New Superhard Materials are Becoming a Reality

To the Editor:

I read *MRS Bulletin* regularly and very often find interesting papers. One such article is David Teter's article on the computational alchemy of superhard materials in the January 1998 (page 22) issue of *MRS Bulletin*. It is pleasant that this report by a young PhD [graduate] contains an extensive bibliography (more than 100 references) including some Russian works. However, unfortunately, the author's attention to nanostructured materials is very limited. It's only at the end where he mentions some results concerning superlattices problems. Several years ago German, American, Swedish, and Russian investigators have demonstrated the high hardness values (more than 50–60 GPa) for multilayer films based on high-melting point compounds such as nitrides, borides, and carbides (see my review in the *J. Mater. Sci.* **32** [1997] p. 4463). It is also interesting that in the case of nanostructured bulks of TiN the hardness value is also 1.5–2 times higher compared with that for conventional sintered or hot-pressed TiN (*Nanostruct. Mater.* **9** [1997] p. 607). It is worth pointing out that in the case of nanostructured metals (copper, palladium, nickel, silver, and others) the hardness increasees on average *four* to *six* times as a result of grain size decrease. Is it possible to move this *hardness increase* from ductile solids to brittle ones such as high-melting point compounds and to reach the diamond hardness value? Now there are only separate results obtained on multilayer films such as TiN+ZrN, TiN+NbN, and TiN+VN which confirm the reality of a new type of superhard materials. The hard work for creating such superhard materials, including synthesis, processing, understanding hardness principles, and development of computational hard materials science, lies ahead.

Rostislav A. Andrievski
Institute for New Chemical Problems
Russian Academy of Sciences

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