Comment on "Evidence for Superconductivity in Low-Temperature–Grown GaAs"

In a recent Letter, Baranowski *et al.* discussed superconductivity in epitaxial layers of GaAs grown at lower than normal substrate temperatures, LT-GaAs [1]. The origin of the superconductivity is not completely understood by the authors, and there is a discussion of various possibilities, including an incompletely described "new, As-rich layered structure." In this Comment, we wish to point out that this observation is consistent with a rich history of published observations of similar T_c's in systems of metals in conjunction with semiconductors, as well as the reports of enhanced T_c's in granular metals such as the Bi clusters cited by the authors. For example, there have been reports of superconductivity on PbTe with excess amounts of Pb and Tl [2,3], and also reports of superconductivity at the surface of radiation-damaged InSb [4].

Our own work in this field was concerned with layers of various metals deposited on PbTe and other semiconductors [5–7] as part of a search for an excitonic mechanism of superconductivity. The metals In, Tl, Al, and Sn were deposited on clean single-crystal PbTe surfaces under UHV conditions, and the transition temperatures were measured *in situ*. To summarize briefly, we found that the highest T_c of In on PbTe was 5.5 K, and even In on single-crystal Te produced T_c's above 6 K. For the other metals, T_c's did not exceed bulk values. The possibility of In displacing Pb from the PbTe surface and forming Pb precipitates was considered, but of course could not explain the results for In on Te. Despite deposition of the metals layers at 77 or 7 K and measurement *in situ* without warming, the possibility of compound formation could not be dismissed, and in the absence of any positive indication for excitonic superconductivity, the work was not pursued further.

The similarity of the T_c's in our work and the present measurements on LT-GaAs layers is interesting. Here too, precipitates and metastable compound formation are possible in this highly nonstoichiometric material. In our case, the possibility of In compounds loomed large, since, for example, T_c in In/Bi compounds can be near 5.6 K, and the formation of a previously unrecorded In/Te compound or alloy with a comparable T_c was always considered to be a possibility. In the present case, metastable Ga compounds or alloys could provide the high T_c, since Ga deposited at low temperature can have a T_c of greater than 8 K.

In summary, we wish to point out that the present work, while interesting, is not the first observation of anomalous T_c's in metal-semiconductor systems. It is clear from this and previous work, however, that there may be some interesting underlying mechanism, and further work seems justified. Whether dreams of semiconductor/superconductor circuits are realized will depend on many factors, one of the most important being the degree to which the observed superconductivity can be made to respond to inputs in material preparation.

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Note added.—The Reply Comment by Baranowski *et al.* indicates that In is involved in the superconductivity found in the GaAs system. Although the T_c's and the details of In compound formation are undoubtedly different, the similarity between the results and the possibility of compound formation in both cases is evident.

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