Pyun and Lemberger Reply: Fiory, Hebard, and Paalanen[1] show tunneling-conductance data on a junction prepared differently from ours.[2] Their data differ from ours in that the conductance is a low power of eV such as $(eV)^{1/3}$ from 2 to 40 mV and is linear in V above 40 mV. Like our data,[2] theirs disagree with data[3] on other materials which show the theoretical $V^{1/2}$ form in the strong-disorder limit. From the difference between their data and ours, they conclude that one must be cautious in interpreting our tunneling-conductance curves as being proportional to the electron density of states in InO_x until interface effects are better understood.

We agree entirely that one cannot be too careful in making and interpreting tunneling measurements as there are so many things to go wrong in the formation of the tunneling barrier. Certainly one's suspicions should be aroused by data like ours which differ in such a striking fashion from data on other systems and from theory. The quality of the junctions must be scrutinized.

There are a number of empirical criteria for junction quality. Chief among these are reproducibility from sample to sample and symmetry in the conductance about zero bias voltage. All of our junctions have these characteristics. The reproducibility of the junctions of Fiory, Hebard, and Paalanen is unclear since they show only one curve, although they mention that other junctions show similar effects; symmetry about zero bias is poor. Hence, we believe that the quality of our junctions is better for the critical range of bias voltages above 5 mV. As described previously,[2] we made numerous tests to ensure that other possible experimental problems did not influence our data. For example, we could not get reliable data at voltages above about 30 mV for 100-Ω junctions, like that shown by Fiory, Hebard, and Paalanen, because the large current densities in the InO_x film induced a resistance per square comparable to the resistance of the junction, and the current through the junction redistributed.[4]

A valuable point made by the data of Fiory, Hebard, and Paalanen is that problems in the junction can cause wide variations in conductance curves on the same material. Thus, if interfacial effects are important, it is surprising that all of our junctions show a correction to the conductance which is precisely logarithmic, regardless of junction resistance, film resistance, and thickness. And the size of the logarithmic correction scales precisely with the resistivity of the InO_x, again independent of junction resistance and InO_x film thickness. An explanation based on a thin surface layer that is only weakly coupled to the bulk, thus being effectively 2D regardless of film thickness, requires a layer less than 10 Å thick to be consistent with no crossover to 3D below 60 mV. This is conceivable but seems unlikely. Moreover, the superconducting density of states, taken from the conductance at low bias voltages on both high- and low-resistance junctions, shows sharp gap structure with some broadening that depends systematically on the resistivity of the InO_x films, supporting our view that the tunneling measurements are probing the bulk of the film and not just surface states.

In conclusion, we support skepticism regarding tunneling measurements. We have performed numerous tests to eliminate spurious effects from our study. These tests, together with the systematics of our results argue for their validity, in spite of the differing data of Fiory, Hebard, and Paalanen.

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[1] A. T. Fiory, A. F. Hebard, and M. A. Paalanen, preceding Comment, Phys. Rev. Lett. **65**, 666 (1990).

[2] D. S. Pyun and T. R. Lemberger, Phys. Rev. Lett. **63**, 2132 (1989).

[3] G. Hertel *et al.*, Phys. Rev. Lett. **50**, 743 (1983), and references therein.

[4] D. S. Pyun and T. R. Lemberger (unpublished).