**Krim Replies:** The work reported here by Renner, Rutledge, and Taborek (RRT) [1] involves an unsuccessful attempt to measure the sliding friction of nitrogen condensed on a lead sample. RRT detected no slippage at their sample's interface and thus could not measure the sliding friction or how it might have changed at the superconducting transition. The technical improvements claimed by RRT focus exclusively on the cryogenic design of the experimental apparatus, leaving issues associated with surface contamination and/or morphology unaddressed. The RRT data are in fact entirely consistent with samples exhibiting greater contamination and/or defect levels than those of Dayo, Alnasrallah, and Krim (DAK) [2]. Specifically, since friction is exceptionally sensitive to surface conditions, its dependence on superconductivity will be unobservable in the presence of a sufficiently thick contaminant layer. While the precise thickness such a layer must attain to prevent the effects from being observed is unknown, successful measurements are extremely unlikely if the contamination layer's thickness exceeds molecular dimensions. The nature and density of interfacial defects will meanwhile have tremendous influence on whether film slippage will even be observed. Here are the primary differences between DAK and RRT.

(1) The sample preparation and postpreparation conditions (pressure, deposition rate, film thickness, deposition substrate condition, and length of exposure of the sample to air) were disclosed by DAK while RRT fail to disclose their sample preparation conditions. The DAK samples were deposited at $10^{-8}$ torr in a chamber constructed entirely of ultrahigh vacuum (UHV) components onto quartz substrates which had been cleaned for UHV conditions in advance of sample preparation. The cryostat where measurements were performed was also constructed exclusively from UHV compatible materials, and was thoroughly outgassed before introduction of the sample.

(2) After adsorption of nitrogen films onto the lead samples at 80 K, the DAK experimental chamber was cooled to 4 K in less than 30 minutes by directly plunging the experimental chamber into a liquid helium bath. In contrast, the RRT chamber was cooled from room temperature to 4 K in 36 hours. Employing the DAK approach, the risk exists that the nitrogen will completely desorb onto the (cooler) chamber walls (whether this in fact happens depends on the details of the chamber geometry). This approach is superior, however, in terms of ensuring that residual contaminants in the gas phase will freeze out on the chamber walls rather than on the sample surface. The amount of nitrogen which remains on the surface upon cooling to 4 K can be directly measured, since the film present on the surface will lower the microbalance's resonant frequency below its empty cell value.

(3) The nonequilibrium nitrogen films grown by RRT through direct deposition of the nitrogen onto a 4 K substrate are almost certainly porous [3], possibly fractal in nature: Their geometry must be exceptionally different from the DAK nitrogen films, and the interface studied must be quite different from that studied by DAK. This may in fact account for the fact that RRT observe no slippage within their experimental resolution: While contamination might obscure the observation of superconductivity-dependent friction, it will not obviously prevent slippage of an adsorbed overlayer. Indeed, the defects present in this geometry may be more comparable in nature to those assumed by the theory of Persson and Volokitin (Ref. [3] in [1]) which RRT cite to argue that pinning is in fact to be expected. The latter theory also predicts pinning for films adsorbed at 77 K, for example, the systems Kr/Au and Xe/Ag, where acceptance of the interpretation of slipping is widespread [4]. The precise role of defects is of great interest, and the RRT result may ultimately help to illuminate this issue.

(4) The RRT measurements were performed with 8 MHz quartz crystals oscillating in a third overtone mode, while the DAK measurements were recorded with 8 MHz crystals oscillating in the fundamental mode. The $3 \times 10^{-7}$ jump in $Q^{-1}$ reported by DAK would therefore correspond to $1 \times 10^{-7}$ or 0.5 divisions in RRT's Fig. 1(a).

The DAK measurements were followed up by mutual inductance measurements similar to those described here by RRT and it was observed that the changes in sliding friction were indeed occurring at the superconducting transition of the microbalance electrodes [5]. In order to eliminate the complications of surface contaminants, work is in progress to repeat the DAK measurements on samples prepared in UHV conditions, followed by transfer to the experimental chamber without air exposure.

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