DISCUSSION

L. D. Roth[1] *(written discussion)*—Could you distinguish between the effect of temperature and that of environment in liquid nitrogen and liquid helium? That is, would you not expect to see the R ratio effect at 77 and 4.2 K if the specimen were tested in air in a refrigerated system at 77 and 4.2 K? I would assume that the liquid nitrogen and liquid helium have a very low solubility of oxygen and hence very little oxide should form. In refrigerated air at the same temperature, however, oxides might form, which would mean this is an environmental effect and not just a temperature effect. Have any tests been performed in oxygenated liquid nitrogen?

P. K. Liaw et al (authors' closure)—At 77 or 4.2 K the lesser effect of load ratio on ΔK_{th} than at 297 K is related to the decreased extent of oxide and roughness-induced crack closure. Even though oxygen is present in a refrigerated air system at 77 or 4.2 K, it is expected that fretting oxidation during near-threshold crack propagation would have difficulty in occurring because of the low diffusion rate of oxygen at cryogenic temperatures. The fracture surfaces in refrigerated air at 77 or 4.2 K may be smoother than those in room temperature air, as observed by the present authors with liquid nitrogen and liquid helium (unpublished work). Therefore, the near-threshold fatigue crack growth rates may be insensitive to load ratio in refrigerated air because of the decreased oxide and roughness-induced crack closure.

The solubility of oxygen is low in liquid nitrogen and liquid helium. However, there is a difference in near-threshold fatigue crack growth rates at 77 and 4.2 K. This behavior suggests that there exists an intrinsic temperature effect on fatigue crack propagation rates.

We did not conduct tests in oxygenated liquid nitrogen.

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