Authors' reply to 'Comment on "J and G_c analysis of the tearing of a highly ductile polymer"'

The comment on our paper [1] by Andrews [2] highlights the difficulties in this area of fracture analysis and a short reply may be useful. There are two quite distinct aspects covered in the paper and it is helpful to separate them clearly.

The energy analysis based on the experimental method of Begley and Landes [3] gives a *total* energy absorption rate for fracture propagation. The analysis here is not applied conventionally as it was previously in metals, but instead is used to describe a propagating crack. However, there is no ambiguity in this definition and no grounds for uncertainty as to what the number means. That such a parameter may be computed from the stress, strain or energy distribution, if they are known, is a matter of fairly straightforward analysis.

Uncertainty arises in the interpretation of J and whether it is a material property and whether in any sense it defines the fracture behaviour in a unique way. It is only in this sense that J is empirical and GFM, as used by Andrews [4], offers an interpretation in terms of the true surface work, T_0, and a function which computes all other energy dissipation throughout the body. For points remote from the crack tip, the computation is sensible but it is less clear when one is concerned with the very local crack tip region. As Andrews observes, there may well be local processes like crazing which cannot be separated by any simple continuum analysis, in which case one may in general have to separate the energy absorption into that which is specific to processes around the crack tip and those which are not. Clearly, if one has a stress analysis, one can, in principle, compute the second of these and by difference find the local part.

A key factor is the difficulty of such computations. Complete numerical descriptions are often attempted, particularly for elastic–plastic bodies and Andrews uses a grid-measuring experimental method. The latter is difficult to perform and the choice of a β value, the hysteresis ratio, for a propagating fracture in a viscoelastic material is not a simple matter. The suggestion made in this paper is that it might be sensible to divide the total energy absorption rate, J, into that which is currently absorbed at the instant of fracture and that which is absorbed prior to the event. It seems reasonable to suppose that the former is supplied by the current energy release rate and this may be deduced from the short-time loading characteristics of the specimens. Such calculations are easy to perform and give G_c values which are not strongly geometry dependent and, it is suggested, could be regarded as fracture characterizing parameters.

References

1. J. M. HODGKINSON and J. G. WILLIAMS, *J. Mater. Sci.* **16** (1981) 50.
2. E. H. ANDREWS, *ibid.* **16** (1981) 1705.
3. J. BEGLEY and J. D. LANDES, *ASTM-STP* 514 (1972) 1.
4. E. H. ANDREWS, *J. Mater. Sci* 9 (1974) 887.

Received 10 October and accepted 13 October 1980

J. G. WILLIAMS
J. M. HODGKINSON
Department of Mechanical Engineering, Imperial College, London, SW7 2BX, UK

0022–2461/81/061707–01$02.10/0

Filamentary and dendritic growth of lead chloride crystals in silica gel

In recent years crystal growth from silica gel has gained a new momentum by virtue of its unusual combination of low temperature growth and exceedingly simple and inexpensive equipment. Extensive work has been carried out on growth mechanisms, characteristics and nucleation of crystals in gels [1–4]. However, dendritic crystals have been grown only in a very few cases [5–8]. The results of experiments on the growth of lead chloride dendrites in gel are reported here.

Growth was accomplished by the counter diffusion of the respective ions through a gel medium of 75 cm^3 of sodium metasilicate solu-

0022–2461/81/061707–04$02.40/0