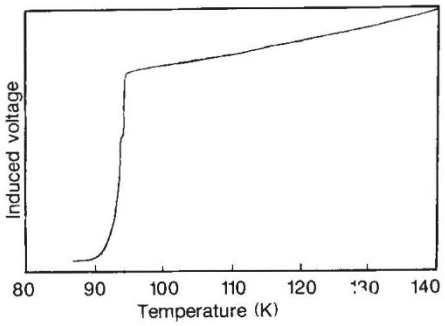
Effect of N_2 on superconductors

SIR—Matthews *et al.*[1] reported that the superconducting transition temperature (T_c) of $YBa_2Cu_3O_y$ ($y \approx 7$) ceramic can be increased by exposure to cold gas. Exposure to nitrogen raised T_c by nearly 40 K. Sarma *et al.*[2], however, performed experiments which led them to suggest that this observation could be explained by condensation of nitrogen gas in the porous ceramic, but Matthews and colleagues have supported their own interpretation by further experiment[3,4]. It is clearly important to establish whether or not the transition temperature of a superconducting ceramic can indeed be raised by such a simple procedure. In an independent investigation, we find no effect of cold nitrogen gas on T_c.



Superconducting transition of encapsulated and unencapsulated half-disks of $YBa_2Cu_3O_7$ ceramic.

Our samples were disks of $YBa_2Cu_3O_y$ ceramic, about 10 mm in diameter and 2 mm thick, supplied by N. Alford of ICI Advanced Materials. Superconductivity was detected by measurements of a.c. susceptibility. The temperature of the specimen-holder was varied by means of the metal-cylinder apparatus described elsewhere[5], in which the specimen holder is held in a vertical column of cold nitrogen gas along which a temperature gradient is established. The temperature of the specimen holder can be varied by raising it to the appropriate height, and was measured using a silicon diode thermometer. When measuring T_c, the temperature was varied at less than 1 K min^{-1}, a rate for which preliminary experiments showed a negligible temperature difference between the specimen and the thermometer. The induction coils were separated from the specimen by a few millimetres so that the surfaces of the latter were exposed to the cold nitrogen gas.

The changes in T_c reported in refs 1, 3 and 4 are so large (up to 40 K) that they should be easy to observe. Nevertheless, to ensure that any change would be detected, we cut one of the specimen disks in half along a diameter. One half was encapsulated, by means of a chemical-dip treatment, and the other was left untreated. The two halves were placed together between the coils. If the nitrogen gas does indeed alter T_c, we should observe two transitions, one in the encapsulated half at the original transition temperature and one in the unencapsulated half at a higher temperature. The a.c. susceptibility of a pair of specimens, as they were first cooled from room temperature to 80 K, is shown in the figure. The small step in the voltage drop shows that the two halves have very slightly different transition temperatures (~ 0.3 K) and that our apparatus would detect any change in the T_c of the unencapsulated specimen.

Experiments were performed on six samples, four of 15% porosity and two of less than 2% porosity. Specimens were exposed to nitrogen gas at 80 K for up to 43 hours, the transition temperature being measured at intervals of a few hours. No change in T_c was observed for any specimen; the variation in a.c. susceptibility with temperature after exposure to cold nitrogen gas was no different to that observed during the initial cooling.

Thus we have not been able to reproduce the increase in T_c observed in refs 1, 3 and 4, nor indeed did we detect any change at all in T_c resulting from exposure to cold nitrogen gas. Moreover, although many other experiments must have involved exposure of ceramics to cold gas for long periods, there is, as far as we are aware, no report of a resulting increase in T_c. We cannot explain the results of Matthews, Taylor and co-workers; there may be a flaw in their experimental method, possibly of the kind suggested by Sarma *et al.*[2], or perhaps their samples are not typical of YBaCuO ceramics.

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Antigen receptor tail clue

SIR—I wish to draw attention to an amino-acid motif present in the cytoplasmic tails of several protein components of the antigen receptors on T cells and B cells[1-4], as well as the immunoglobulin E (IgE) receptor ($Fc_\varepsilon RI$) on mast cells[5]. These receptors show similar structural and functional properties; they consist of several different transmembrane proteins which upon cross-linking generate a signal resulting in cell activation.

As shown in the figure, the motif is found in the CD3-γ, -δ and -ζ components of the T-cell receptor (but not the CD3-ε or TcR-α or -β, components); in the MB1 component of the immunoglobulin M antigen receptor on B cells and on the $Fc_\varepsilon RI$-β and -γ components of the receptor for IgE on mast cells (but not the Fc_ε RI-α component). When the consensus sequence motif derived from these components was used to search the NBRF protein databank for related protein, two were identified: a B-cell-specific membrane protein, B29, of unknown function[8] and the envelope protein, gp30, of bovine leukaemia virus (BLV)[6,7].

The first two specified amino acids of the motif are the negatively charged aspartic acid (D) or glutamic acid (E); the third and fifth are tyrosine (Y); and the fourth and sixth are leucine (L) or isoleucine (I). All six are located with a precise spacing between each other, and would lie on the same side of an α-helical barrel if the cytoplasmic sequence formed an α-helix. On cross-linking of receptor, the conserved amino acids from several chains may come together to form a binding site for the putative proteins that generate the

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h CD3-γ      GQDGVRQSRASDKQTLLPNDQLYQPLKDREDDQYSHLQGNQLRRN
mCD3-γ       ----------------------Q-E----------Y----------KK
h CD3-δ      -HETG-L-G-A-T-A--R---V-----R--D-A-----G--WA-N-
mCD3-δ       -HETG-P-G-AEV-A--K-E-------R----T---S-G--WP-N-KS
mCD3-ζ       ADAYSDIGTKGERRRGKGH-G---G-STATK-T-DA-HMQT-APR
BLVgp30      LKLLRQAPHFPEISLTPKP-SD--A-LPSAPEI-----SPVKPDYINLRPCP
h MB-1       RKRWQNEKLGL-AGDEYEDEN--EG-NLDDCSM-EDISRGLQGTYQDVGSLNIAD
mMB-1        RKRWQNEKFGV-MPDDYEDEN--EG-NLDDCSM-EDISRGLQGTYQDVGNLHIGD
mB29               DKD-GKAGMEE-HT-EG-NIDQTAT-EDIVTLRTGEVKWSVGEHPGQ
rFcεRI-γ     RLKI-V-KA-IASREKS-AV-TG-NT-NQET-ET-KHEKPPQ
rFcεRI-β       Y-IGQEFE.RSKV-D-R--EE-.HVYSPI--A-EDTREASAPVVS

Consensus:     DxxxxxxxDxxYxxLxxxxxxxYxxL
                     E       E             I
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Sequences are aligned by means of the six consensus amino acids of the motif (boxed). Identical amino acids are indicated by –, gaps by .; h, human; m, mouse; r, rat. For all sequences except CD3-ζ and BLV gp30, the sequence shown begins with the first cytoplasmic amino acid; for all except MB–1 (whose human sequences our unpublished sequence) and B29, the sequence shown ends with the C terminus of the protein.