that of any of the ordinary pulses. The width of a 'giant pulse' is about 60 ns.

Similar results were obtained with two kinds of germanium mirror, namely, an evaporated film on an optically flat silica substrate and a mechanically polished single crystal of intrinsic material.

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An Explanation of the High Strain Fatigue Law in Terms of the Statistical Distribution of Strains

Many investigators, particularly L. F. Coffin, have found that the high-strain fatigue endurance of a wide range of metals and alloys is represented by a law of the following type:

$$\varepsilon\sqrt{N} = \varepsilon_0/2 \qquad (1)$$

where ε is the plastic strain-range, N is the number of cycles to cause rupture, ε_0 is the unidirectional strain-at-rupture.

Despite its general applicability, no acceptable explanation of equation (1) has, until now, been advanced.

It is proposed to regard the specimen as comprising a large number n of small elements of volume. During a specific plastic strain-reversal, ε, let a fraction x of the deformation-systems in such an element be operative. Then the plastic strain is accommodated by the deformable fraction, which therefore undergoes a strain $(\varepsilon)1/x$. Hence the variance of the strains to which all of the elements are subjected is $1/n(\varepsilon)^2\Sigma 1/x^2$, that is, proportional to $(\varepsilon)^2$.

Assuming (reasonably) that there is no significant long-term correlation between the microscopic deformation systems operative in successive plastic strain-cycles, the variance after N cycles will, by the law of addition for variances, be proportional to $N(\varepsilon)^2$ and the standard deviation will be proportional to $\varepsilon\sqrt{N}$. Failure is asserted to have occurred when a specific fraction, y, of the specimen has undergone a strain exceeding the unidirectional ductility, ε_0. When the specimen is in this condition, a negligible number of further cycles will break it into two pieces. The condition for failure is then $\varepsilon\sqrt{N} = \sigma_{\text{lim}} = f(\varepsilon_0)$, which is equation (1) when $f(\varepsilon_0) = \varepsilon_0/2$.

The central difficulty in explaining equation (1) has always been its general applicability. This difficulty is now removed since the explanation here advanced is one which implies that equation (1) should apply to all plastically fatigued materials which exhibit plastic heterogeneity.

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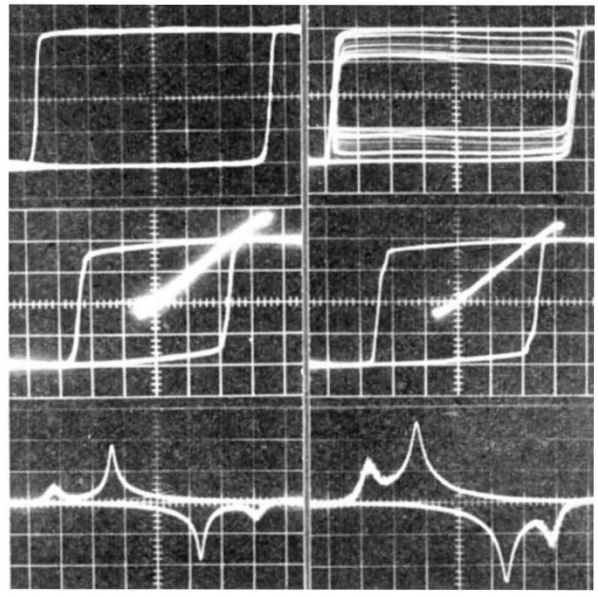
Uniaxial Anisotropy 'Permalloy' Films grown in a Glow Discharge on Sputtered Tantalum Substrates

It is well known[1] that the magnetization reversal mechanism in a thin 'Permalloy' film is related to the degree to which a truly uniaxial anisotropy can be induced on a microscopic scale. Once the magnetostrictive and crystal anisotropy has been minimized by carefully controlling the composition of the film, the surface morphology of the substrate on which the NiFe is to be deposited can play a dominant part in determining H_c and H_K and the angular dispersion of the easy axis of magnetization. In magnetic memory applications it is expedient to deposit the 'Permalloy' film on to a highly conducting metal ground plane which will be in close proximity to the memory bits in order to reduce both the memory noise and the drive power of the memory array. However, in practice it has not been possible to deposit a thin NiFe film directly on to such a metal ground plane and obtain uniform magnetic properties over large substrate areas, that is, 100 cm^2. Magnetic and electron microscopy investigations have shown[2] that this is partially due to the fact that mechanical polishing techniques cannot adequately produce the smooth surface characteristics necessary to avoid the inhibition of domain wall motion. In addition, recent work in this laboratory on sputtered NiFe films on very highly polished Ag or Ag.Cu or Au metal planes has shown that significant amounts of the face-centred cubic NiFe diffuses into these face-centred cubic metal substrates during deposition in the glow discharge, resulting in completely isotropic magnetic films. These problems can be overcome by depositing an intermediate layer which is thick enough to serve both as a diffusion barrier which does not replicate the topography of the underlying metal ground plane and at the same time has a minimum of granular structure of its own[3]. An evaporated SiO film, $>10{,}000$ Å, can adequately fulfil these needs[2]; however, reproducibility over large areas is difficult. The chemistry of Si_xO_y vaporization and the susceptibility of this material to gettering reactions at the substrate with the associated microscopic morphology and anisotropic film stress[4] problems all lead to a rather complex system to control accurately. Relatively few alternative thin film materials will adequately fulfil the diffusion barrier and morphology requirements in the deposition temperature-range, 300°–400° C, found necessary[5] for uniaxial anisotropy sputtered NiFe films. The possibility of using a thin film of a refractory metal such as tantalum was considered since this would have a low surface mobility on the metal ground plane and would be less susceptible to formation of large granules during the NiFe deposition. Alloying of NiFe with body-centred cubic refractory metals should also not be as serious a problem.

The physical sputtering process rather than evaporation is ideally suited for the deposition of such refractory



a *b*

Fig. 1. 60 cycle B.H. loops on sputtered NiFe films 700 Å thick. *a*, NiFe on glass: H_c = 3·9 œ, H_K = 2·9 œ, differential at 45°; *b*, NiFe on 2000 Å tantalum on glass: H_c = 4·2 œ, H_K = 2·8 œ, differential at 45°