of the two compounds were attributed to the anisotropic 4f-crystal field interaction. The anomalies in the temperature dependence of the elastic constants, observed in both $DyAl_2$ and $GdAl_2$ at their Curie points, 54 and 176°K, respectively, indicate the presence of magneto-elastic effects in both compounds. In $GdAl_2$ the magnetic transition is displayed by a smooth change in slope of C_{ij} versus temperature. The change is maximal for the pure elastic constants C_{44} and $(C_{11}-C_{12})$. The anomaly in $DyAl_2$ is dip-like for all three elastic constants C_{11}, C_{44} and $(C_{11}-C_{12})$. The differences between the elastic properties of these two compounds were attributed to the aspherical 4f character of Dy^{+3} as opposed to the spherical S-state Gd^{+3} which interacts isotropically with the crystal fields.

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THE ULTRASONIC EQUATION OF STATE IN THE VICINITY OF THE MARTENSITIC TRANSFORMATION IN Au - 47.5 at.%Cd[1]

Y. Gefen and M. Rosen

The isotropic elastic constants of Au - 47.5 at.%Cd, and their hydrostatic pressure derivatives, within the temperature interval (10-95°C) of the thermoelastic martensitic transformation, were determined. From the experimental data, using ultrasonic techniques at hydrostatic pressures (up to 5 kbar), the temperature dependence of the isothermal equation of state of the cubic β-phase was calculated. It was found that the low-temperature orthorhombic β'-phase is elastically softer than the cubic β-phase, consequently affecting the $\beta \rightleftarrows \beta'$ transformation kinetics upon application of hydrostatic pressure. The high values of the Grüneisen parameter, calculated from the pressure derivatives of the sound velocities, in the orthorhombic β'-phase are indicative of a high anharmonicity of inter-atomic potential in the vicinity of the $\beta' \rightarrow \beta$ phase transformation.

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TRANSGRANULAR CRACKING IN COLD WORKED IRRADIATED 304L STAINLESS STEEL

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Cracks were periscopically observed on the surface of a 304L stainless steel (SS) tube (Fig. 13) in service for several years in an experimental irradiation system in the core of the IRR-2 water-cooled reactor. Such cracks were found only in the region of the tube which during irradiation was just above the water surface. This cracked region was covered with a white deposit (Fig. 13)

Fig. 13
Deposit and cracks on surface of irradiated stainless steel tube

Hot cell optical microscopy revealed the following: (1) Cracks originating on the outer surface, with some penetrating the entire tube wall. (2) Cracking with well-defined branching (Fig. 14), mainly transgranular. (3) Groups of parallel line markings (Fig. 15 and 16) and many microcracks parallel with these markings.

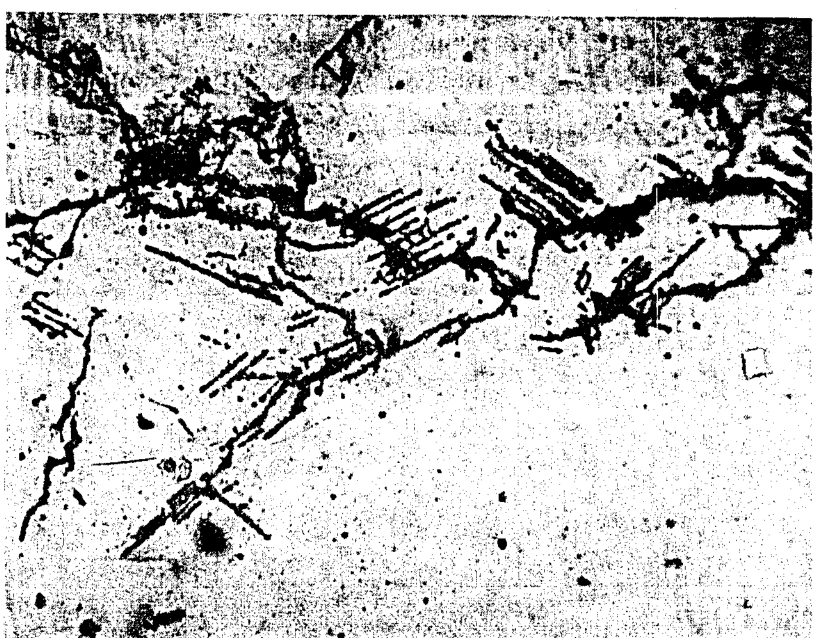

Fig. 14
Branching and microcracks in irradiated stainless steel tube.
As polished, Mag: 400 X

Fig. 15

Transgranular cracking of irradiated stainless steel tube.
Etched, Mag: 400 X

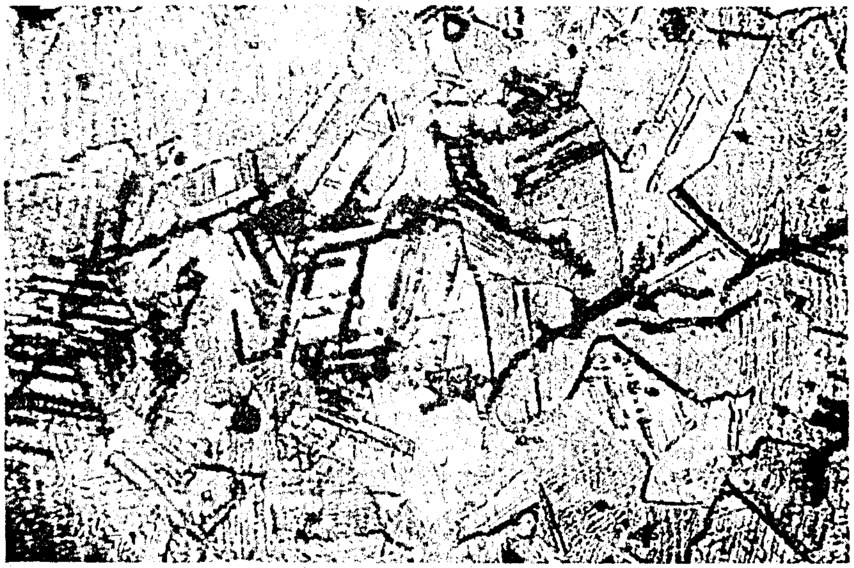

Fig. 16

Microcracks parallel to line markings in irradiated stainless steel tube.
Etched, Mag: 400 X

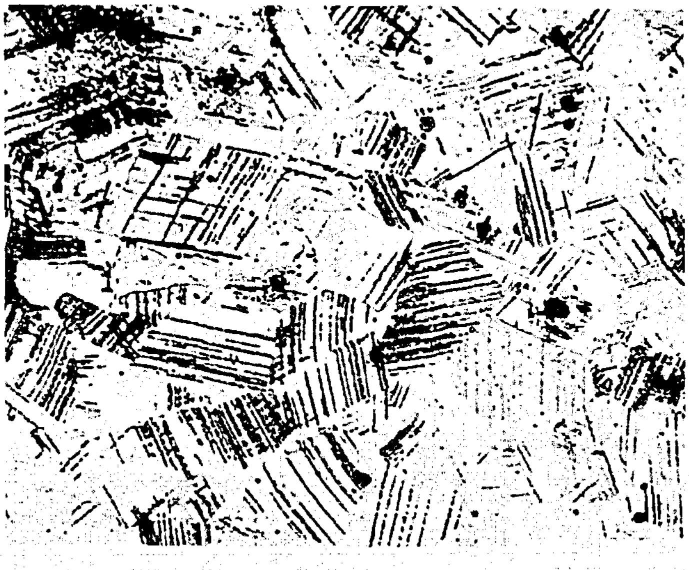

Fig. 17

Line markings in unirradiated stainless steel tube.
Etched, Mag: 400 X

Groups of parallel line markings were also observed on metallographic sections of an unirradiated tube (Fig. 17). The line markings are probably the result of cold working during the production of the SS tubes. Poor elongation (6-7%) and high hardness (about 240 HV) are evidence of the unannealed condition of the tubes.

Powder X-ray diffraction indicated that the deposit is a mixture of boehmite and gibbsite. It is assumed that periodical wetting and drying of the irradiated SS tube, near the water surface, resulted in the precipitation of a porous alumina deposit on the surface. In the coated region a relatively high concentration of halides may have accumulated during the periodic wetting. Warren[1] has demonstrated that the transport of low concentrated chloride solutions through a porous material to a metal surface causes branched transgranular cracking.

Stress-assisted corrosion cracking of austenitic alloys in water-cooled nuclear reactors has been reviewed recently[2]. In most of the reported cases the cracking was intergranular and associated with oxygen, caustic or hydrogen, whereas all mentioned cases of transgranular cracking were connected with chlorides or fluorides. Edeleanu[3] observed chloride-induced transgranular stress corrosion cracking and associated it with parallel lines, which he called quasi martensite. Others[4] relate such transgranular cracking to slip.

In summary, it is believed that the observed cracking is the result of a combined effect of irradiation-assisted stress corrosion cracking in an unannealed material with internal residual stresses. The porous alumina deposit on the tube surface considerably raised the halide concentration in the coated region.

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