

Soft Ferromagnetic Properties of Some Amorphous Alloys

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journal or publication title	Science reports of the Research Institutes, Tohoku University. Ser. A, Physics, chemistry and metallurgy
volume	26
page range	97-98
year	1976
URL	http://hdl.handle.net/10097/27791

Time-of-Flight Pulsed Neutron Diffraction of Pd_{0.8}-Si_{0.2} Amorphous Alloy Using the Electron Linac

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Mater. Sci. Eng., **23** (1976), 215. (Proc. 2nd Intern. Conf. on Rapidly Quenched Metals (Section II), MIT, Cambridge, Mass., 1975)

The structure factor $S(Q)$ of Pd_{0.8}-Si_{0.2} amorphous alloy was measured over wide range of Q ($=4\pi \sin \theta/\lambda$) up to 40 \AA^{-1} by time-of-flight neutron diffraction using pulsed epithermal-neutron generated from the Tohoku University electron linac. The $S(Q)$ has definitely shown an oscillation even in range of $Q \gtrsim 25 \text{ \AA}^{-1}$. The 1st peak of the pair distribution function Fourier transformed from the $S(Q)$ has been split into two sub-peaks at the position of 2.42 and 2.81 \AA . Combining the neutron result with the X-ray result, the 1st sub-peak was verified to correspond to Pd-Si pair and the 2nd sub-peak the mixture of Pd-Pd pair and Pd-Si pair where Pd atom was substituted with Si atom. The average numbers of the nearest neighbour atoms around the Pd atom at origin are 1.7 Si atoms in the 1st sub-peak and 10.7 Pd and 1.5 Si atoms in the 2nd sub-peak. There may be no Si-Si pair with the nearest interatomic distance in the alloy. Such a relation for atom-atom pairs is found in the crystalline Pd₃Si compound, too. The liquid structure of the alloy was also measured and concluded to be essentially close to the amorphous structure except more blurring of peaks.

Propagation of Fatigue Cracks in Amorphous Metals

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Mater. Sci. Eng., **23** (1976), 231. (Proc. 2nd Intern. Conf. on Rapidly Quenched Metals (Section II), MIT, Cambridge, Mass., 1975)

To clarify the property of fatigue fracture in amorphous metals, observations were made on the propagation of fatigue cracks in amorphous Pd-20 at.% Si alloy sheets (60–65 μ thick). The process of fatigue fracture was revealed to be divided into three stages, i.e., the nucleation of a crack, its gradual propagation, and final unstable fracture. The rate of the propagation (dl/dN) was expressed as

$$dl/dN = CK_I^n, \quad n \simeq 4$$

where C is a constant.

A plastic zone existed around the fatigue crack, in which a large number of slip lines were concentrated exclusively. The propagation of fatigue cracks on the specimen surfaces occurred along these slip lines, which were not so-called persistent slip bands, but ones having a single slip step of about 0.5 μ in height.

Soft Ferromagnetic Properties of Some Amorphous Alloys

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Mater. Sci. Eng., **23** (1976), 281. (Proc. 2nd Intern. Conf. on Rapidly Quenched Metals (Section II), MIT, Cambridge, Mass., 1975)

In rapidly quenched amorphous alloys of $(\text{Fe}_{1-x}\text{Co}_x)_{80}\text{P}_{13}\text{C}_7$ and $(\text{Fe}_{1-x}\text{Co}_x)_{75}$ -

$\text{Si}_{15}\text{B}_{10}$, it was found that the zero magnetostrictive alloys are remarkably soft magnetic materials, while the magnetostrictive alloys have rather large coercive force. To investigate the effect of magnetostriction on the properties of the B-H loop, some fundamental magnetic properties in these alloys were studied. The magnetic domain pattern observed by Bitter's method shows a periodic domain structure consisting of 180° and maze domain walls (the periodicity can be seen along the specimen long axis) in all the magnetostrictive alloys, suggesting the existence of magnetic anisotropy whose easy axis varies locally. The estimated value of the anisotropy energy varies with x similar to the composition dependence of magnetostriction. Torque measurements support the above estimation. The coercive force also varies with x and is nearly proportional to the magnetostriction to magnetization ratio. It is, therefore, considered that the anisotropy is caused by the anisotropic internal stress field, and that the stress fluctuation which inevitably exists is responsible for the large coercive force.

Extremely High Corrosion Resistance of Chromium-Bearing Amorphous Iron Alloys

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Mater. Sci. Eng., **23** (1976), 285. (Proc. 2nd Intern. Conf. on Rapidly Quenched Metals (Section II), MIT, Cambridge, Mass., 1975)

Amorphous iron alloys containing 8 at.% or more chromium did not suffer pitting and crevice corrosion, and no detectable weight change was observed after immersion for a week in several neutral and acidic solutions in which ordinary stainless steels unavoidably suffer pitting and crevice corrosion. According to ESCA study, passive film on the amorphous Fe-Cr-P-C alloy consisted mainly of protective chromium oxy-hydroxide and contained some bound water. Electrochemical measurements revealed that more uniform passive film was formed on the amorphous alloy as compared with crystalline alloy having the same composition inasmuch as the amorphous alloy is composed of a homogeneous single phase without crystal defects acting as initiation sites for corrosion. The formation rate of passive film on the amorphous alloy was higher than that on ordinary stainless steels because of high reactivity of amorphous alloy without passive film. Consequently, extremely high corrosion resistance of the amorphous alloys can be interpreted in terms of rapid formation of thick, uniform, highly corrosion resistant passive film.

The Internal Friction and Elastic Modulus of Amorphous Pd-Si and Fe-P-C Alloys

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J. Non-Cryst. Solid, **21** (1976), 688.

The internal friction and the shear modulus of the amorphous $\text{Pd}_{80}\text{Si}_{20}$, $\text{Fe}_{80}\text{P}_{13}\text{C}_7$ and $\text{Fe}_{50}\text{Ni}_{33}\text{P}_{12}\text{C}_5$ alloys have been measured at about 0.5 Hz over