DOMAIN STRUCTURES OF ALNICO V

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Investigations have shown that the type of the domain structure which has been observed on a basal surface of Alnico V alloy is dependent on the size of specimen measured in that plane. It has been found that when the cross-sectional area of the specimen is reduced to $0.5 \times 0.5 \times 1$cm, the domain structure, present in each grain in the form of concentric circles, is transformed into a labyrinth structure in the central part of the specimen and into a form with large concentric circles exeeding the grain boundaries in their external part. No relationship seems to exist between the type of the domain structure and the shape of the specimen.

In the papers [1–3] it has been shown that in a polycrystalline Alnico V alloy, the presence of irregular domain structures, having the form of digital imprints [1], circular spots [2] or concentric circles [3] could be observed on a basal surface, *i.e.*, in a plane perpendicular to the external magnetic field applied during the heat treatment process. On the other hand, on the axial surfaces, *i.e.*, on the planes parallel to the external magnetic field, parallel Bloch walls have been revealed which separated from each other the main domains [1–4] magnetised in alternately opposed directions. Observation has been carried out by using specimens differing from each other in chemical composition, crystalline structure and external shape. This circumstance renders impossible an absolute determination of the causes leading to the formation of complex domain structures on the basal surface of a specimen.

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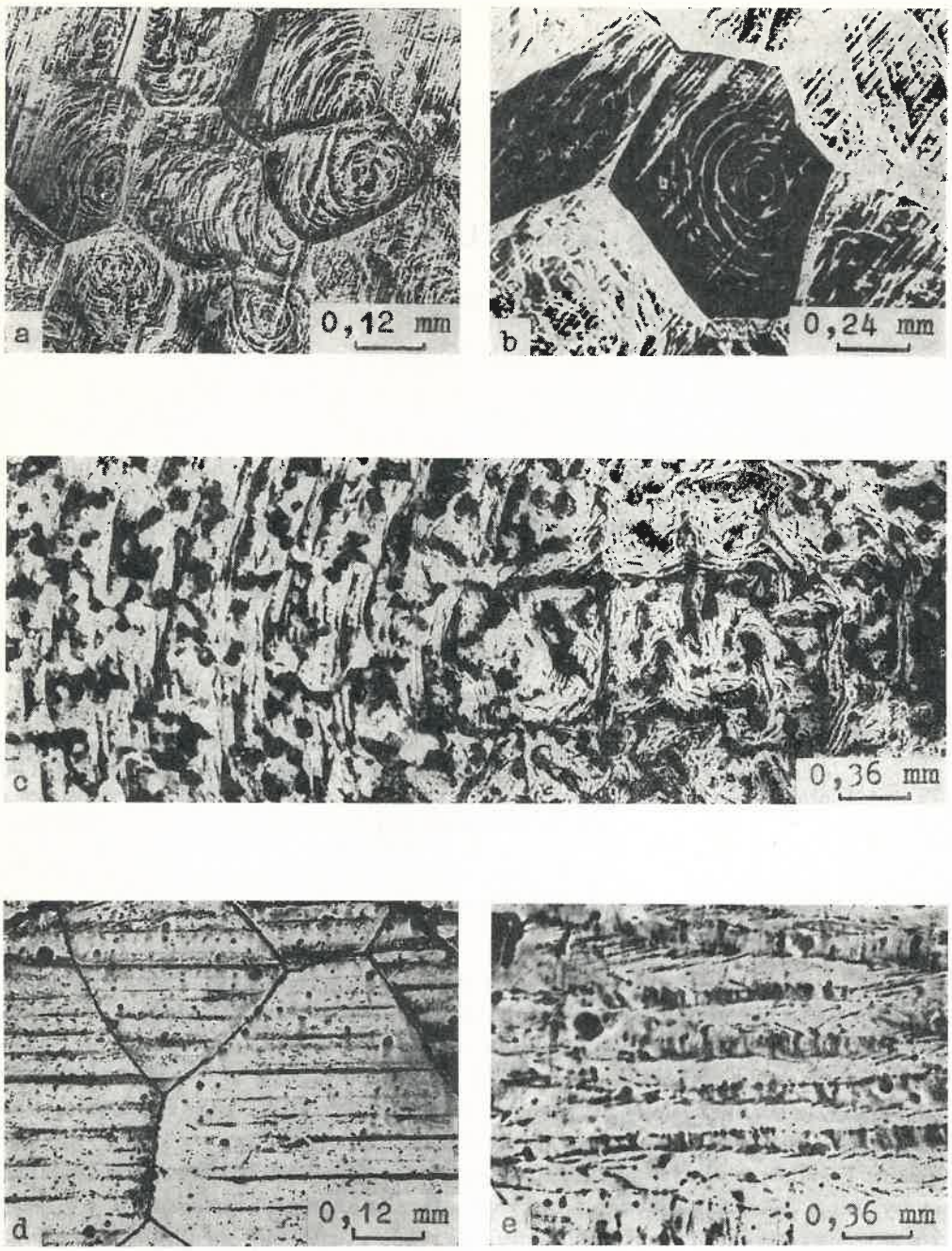

Fig. 1. Powder patterns on the basal surface (a, b, c) of Alnico V alloy show the dependence between the type of the domain structure and the size of the specimen measured in the basal plane. Domain structure shown in Fig. 1a and 1b (in a dark field) relates to the size of $2 \times 2 \times 1$ cm, and in Fig. 1c to that of $0.5 \times 0.5 \times 1$cm. Powder patterns shown in (d, e) relate to the axial surface of the specimen

The present work has been aimed at determining the effect produced by the shape and size of the basal surface of a specimen on the domain structure of Alnico alloy.

Observation of the domain structure has been made in specimens similar in chemical composition (25% Co, 13.5% Ni, 8% Al, 3% Cu, 50.5% Fe) and of identical crystalline structure. The specimens used had either rectangular faces and a square cross-section or were cylindrical in form. The width of specimens, measured in the direction parallel to that of the magnetic field applied during the heat treatment was identical, *i.e.*, always 1 cm. On the other hand, the dimensions of specimens in the direction perpendicular to the external magnetic field varied from 2 cm to 0.2 cm. The surface finish of specimens was obtained by mechanical polishing followed by electrolytic treatment. Observation of the domain structure has been carried out with the aid of a metallographic microscope and by applying the known powder-pattern technique [5].

Fig. 1a, b and c show some typical powder patterns observed an a basal surface of a rectangular specimen, with the basal surface having a size outside the definite critical width below and above which the domain structure is substantially changed. Powder patterns 1a and 1b, observed in a dark field, relate to the specimen of $2 \times 2 \times 1$ cm size; whereas 1c to that of $0.5 \times 0.5 \times 1$ cm size. The corresponding domain structures on the axial surface of a specimen are shown in Fig. 1d and 1e.

A characteristic feature of the domain structure shown in Fig. 1a and 1b is the fact that in each grain the powder patterns have the form of concentric circles. This type of domain structure remains unchanged while the basal surface is reduced to about $0.5 \times 0.5 \times 1$ cm. Below that thickness the domain structure undergoes a change and it consists of labyrinth figures in the central part of the specimen (left side of the Fig. 1c), and of large concentric circles in its external part. It is noteworthy that the Bloch walls of these structures traverse the grain boundaries in a continuous way.

It has been found that in specimens of cylindrical shape the domain structures are substantially similar to those shown in Fig. 1. This shows that in Alnico V alloy the domain structure is not dependent on the external shape of a specimen.

On the axial surfaces, parallel Bloch walls which separate from each other domains magnetised alternately in opposed directions have been observed. This is in agreement with the results obtained in previous works *e.g.* [4].

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