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The twin-related laths in an Fe–17.2 wt % Cr–7.34 wt % Ni–0.2 wt % C alloy

The increase in fracture elongation is found in two-phase (austenite and ferrite) Fe–23.19 wt % Cr–4.91 wt % Ni–0.025 wt % C alloys containing 10 and 52% volume fractions of austenite [1], and it is called transformation-induced plasticity (TRIP effect) because it is induced by martensitic transformation. In the 52% austenite specimen, the elongation has a maximum value at 223 K in a test temperature range M_s (77 K) to M_d (251 K), and the percentage of twin-related laths at 223 K is 100%, which is larger than at other test temperatures [2, 3]. M_s is defined as the temperature at which lath martensite forms first during cooling, and M_d the highest temperature at which lath formation is induced during tensile deformation. In addition, it is found that the morphology of stress-induced martensite is a lath-shaped martensite [1] and several laths constitute a bundle with the same orientation of plane [2, 3]. The TRIP effect is effected by a recrystallization texture of austenite in the 52% γ-specimen [4], and tensile properties such as elongation, yield stress and tensile strength increase with increasing austenite fraction from 10% to 52% in case of the two-phase Fe–23.19 wt % Cr–4.91 wt % Ni–0.025 wt % C steel [5]. γ indicates the austenite phase in the two-phase (austenite and ferrite) alloy. It has been reported in a metastable austenitic Fe–17.2 wt % Cr–7.34 wt % Ni alloy containing 0.2 wt % C that the TRIP effect is also shown in a temperature range M_s (77 K) to M_d (348 K) [6].

In the present study, the orientation relationship between adjacent laths is examined at the temperature of maximum fracture elongation (295 K) by transmission electron microscopy, and the result is compared with the percentage of twin-related laths in the two-phase alloy.

Table I shows the percentage of twin-related laths at 223 K, 171 K, 123 K and 77 K in the 52% γ-specimen. In the 52% γ-specimen, fracture elongation has a maximum value at 223 K and decreases with decreasing test temperature from 223 K to 77 K [1, 3]. In the 100% γ-specimen, 295 K is the temperature of maximum elongation and fracture elongation decreases with decreasing test temperature to 251 K and additional lower test temperatures [6]. As indicated in Table I, the percentages of adjacent laths, whose orientation relationship is a twin relationship, are 100% (223 K), 82% (171 K), 67% (123 K) and 64% (77 K) for the 52% γ-specimen, and 86% (295 K) and 67% (251 K) for the 100% γ-Fe–17.2 wt % Cr–7.34 wt % Ni–0.2 wt % C alloy. Thus, the percentage of twin-related laths is found to decrease in a similar way to fracture elongation in the case of the Fe–17.2 wt % Cr–7.34 wt % Ni–0.2 wt % C alloy. The result agrees with the

TABLE I The percentage of twin-related laths in 52% and 100% γ-specimens

Specimen	Test temperature (K)	Number of sample	Orientation relationship		Percentage of twin-related laths (%)
			Twin-related	Not twin-related	
52% γ	223	25	25	0	100
	171	22	18	4	82
	123	18	12	6	67
	77	22	14	8	64
100% γ	295	14	12	2	86
	251	9	6	3	67

observation of the 52% γ-Fe–23.19 wt% Cr–4.91 wt% Ni–0.025 wt% C alloy.

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Chemical polishes for {1 0 0}, {1 1 0} and {1 1 1} MgO surfaces

Stokes *et al.* [1] discovered almost 20 years ago that {1 0 0} MgO single crystal surfaces can be chemically polished by immersion for 1 min in a boiling 85 wt% solution of H_3PO_4 in H_2O. Since then many investigators have published claims for the efficacy of variants of this procedure, often without supplying sufficient experimental detail to enable others to reproduce their results. For example, Stokes [2] recommended using 4 parts of H_3PO_4 (concentration unspecified) diluted with 1 part of H_2O, while Groves [3] suggested adding 2 to 3 wt% of either concentrated H_2SO_4 or concentrated HNO_3 to a 67 wt% solution of H_3PO_4. Similarly, Ghosh and Clarke [4] found that an 88 wt% solution of H_3PO_4 caused etching rather than polishing at temperatures less than 125° C, whereas Elkington *et al.* [5] and Ogawa [6] reported polishing satisfactorily in H_3PO_4 solutions of unspecified concentration at 110° C and 120° C, respectively.

In addition, Ogawa [6] has succeeded in using a jet polishing method to chemically thin {1 1 0} oriented MgO slices in H_3PO_4 of unspecified concentration at 120° C; and Rice [7] has polished not only {1 0 0}, {1 1 0} and {1 1 1} oriented single crystal surfaces, but also the surfaces of polycrystalline samples, in boiling H_3PO_4 solutions, although he gives no details of the precise experimental conditions he employed.

In an attempt to remedy this situation, the present authors have made a detailed study of the conditions leading to the optimum chemical polishing of {1 0 0}, {1 1 0} and {1 1 1} surfaces of MgO single crystals. Spectrochemical analyses of these crystals are reported in Table I, and show the impurity content to vary considerably from crystal to crystal.

All specimens took the form of flat slabs ~ 1 cm × 1 cm × 0.5 cm in size. Those having their largest surfaces parallel to {1 0 0} were shaped by cleavage, and those oriented parallel to {1 1 0} and {1 1 1} were cut to shape with a water-cooled diamond saw. Then, because the impact studies for which these specimens were intended required flat rather than slightly undulating surfaces, all slabs were polished mechanically, first on wet SiC papers down to 600 grit, and then with Al_2O_3 slurries of down to 0.05 μm particle size. This procedure reduced the amount of damaged material needing to be removed chemically, and hence reduced the polishing time and the opportunity for undulations to develop. It was not, however, a necessary prerequisite for successful chemical polishing, for other experiments showed that equally damage-free – though slightly undulating – surfaces

TABLE I Spectrochemical analyses of specimens

Element	Concentration (p.p.m.)
Ca	100–200
Al	40–100
Mn	50
Fe	100–200
Si	50
Ti	20–50

No trace was found of Sr, Ba, Be, Cu, Ag, B, Cr, V, Ni, Mo, Pb, Bi, Ge, In or Zr.