XMaS the UK-CRG	**Experiment title:** Effect of preferred orientation on stacking fault density in CoCrPtTa thin films	**Experiment number**: 28-01-54
Beamline: **BM 28**	**Date of experiment**: from: 8/9/99 to: 12/9/99	**Date of report**: 18th October 2000
Shifts: 12	**Local contact(s)**: Dr. Simon Brown	*Received at XMaS:*

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Report:

In this short experiment we obtained grazing incidence in-plane diffraction data for two CoCrPtTa thin films using techniques developed during previous experiments (see reports 28-01-34 and 28-01-35). These films were deposited on either a CrMn underlayer to achieve a (1120) preferred orientation (PO) of the Co in the growth direction or on NiAl/CrMn underlayers to seed a (1010) PO. A paper on the work presented in this report has been submitted to J.Appl.Phys. (to be presented at MMM-Intermag 2001) [1] and a further journal paper is in preparation [2]. The aim of the experiment was to investigate whether a change in texture of the Co-alloy in the growth direction would change the stacking fault density. By fitting the X-ray data, we are able to quantify the level of stacking faults in each film so that a quantitative assessment of their effect on the magnetisation reversal processes can be made. There are three types of stacking fault in hcp materials; these are shown schematically in Fig. 1. When a growth or deformation fault occurs, one or two planes are locally fcc respectivelywhilst the stacking is hcp above and below the fault and we denote the probabilities of these faults occurring as α and β respectively. The third type is known as a correlated deformation fault and it is essentially regions or repeated or 'true' fcc stacking and we denote the probability of this fault occurring as γ.

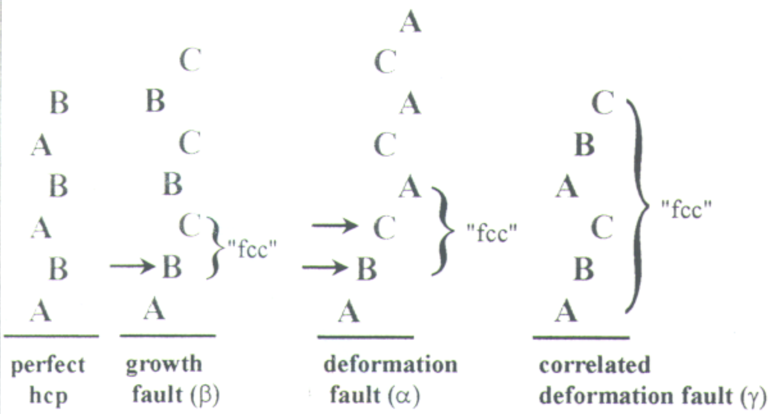

Fig. 1 Stacking faults in hcp materials

Fig. 2 shows horizontal 2θ data collected during 12 hour scans for the two samples (offset for clarity) where the fits to the data are shown as solid lines. By following the analysis of Warren [3] the stacking faults were obtained from the fits to the data in Fig. 2 Full details of the analysis of the fitted data is described in our previous paper but briefly the growth (α) and deformation (β) probabilities are calculated from the broadening of the (101), (102) and (103) peaks once other corrections (e.g. due to grain-size effects) are subtracted [4]. The 'true ' fcc stacking (γ) is estimated from the ratio of the integrated intensities of the fcc (111) peak to the hcp (002) peak . Since γ is typically around 3%, it is essential that very high quality data is obtained so that we can obtain a very accurate fit to the weak fcc (111) peak which is buried in the signal from the hcp (002) peak (see Fig. 2). Since the quality of the data we are able to obtain at XMaS is very high, we are able to estimate the total amount of fcc regions in the films to within 1%. In these two samples, the levels of fcc-like regions in the samples was found to be 13±1% for the (1010) and 8±1% for the (1010).

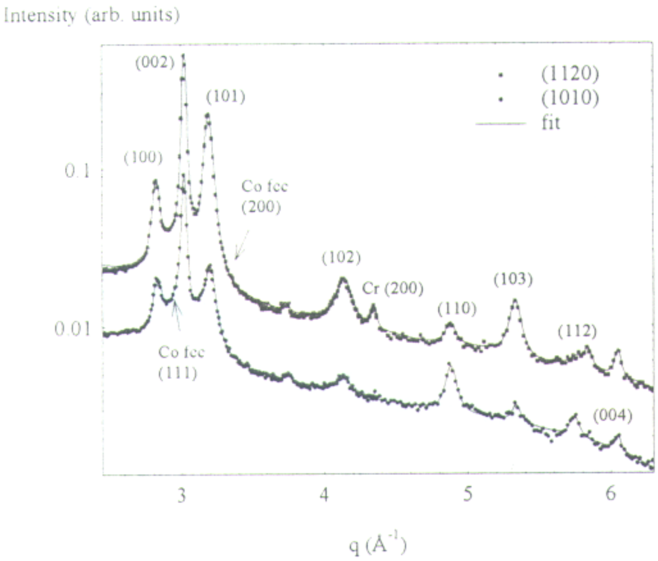

Fig. 2 Horizontal 2θ Scans (12 hour scans)

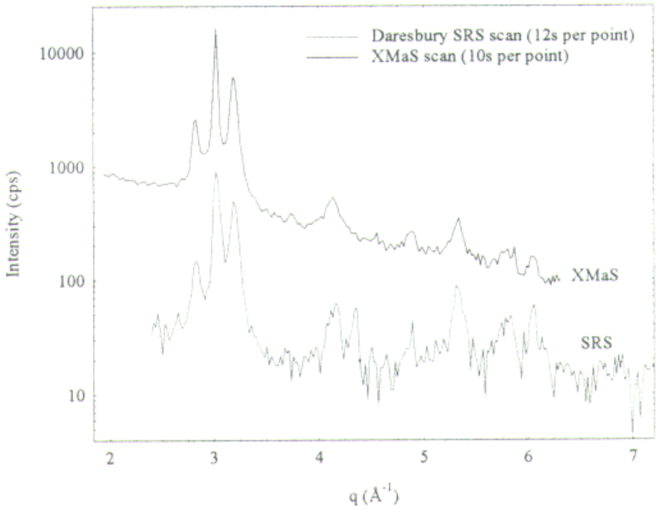

Fig. 3 Comparison of Daresbury and XMaS

For comparison, Fig. 3 shows data obtained on St. 16.3 at Daresbury SRS and on XMaS using count times of 12s and 10s per point (cf. data in Fig. 2 for fitting used count times of 40s per point). These data cannot be compared directly as much lower resolution Soller slits were used at Daresbury to maximize the count-rate (17mrad cf 1.7mrad at XMaS) which accounts for the inherently broader diffraction peaks seen in the Daresbury data. It is clear from this data that the count rate at Daresbury was reduced 20-fold in comparison to comparable data at XMaS. This implies that in order to get data of sufficient quality for fitting purposes to allow stacking fault determination to within 1%, 10 day scans for each samples would be necessary. It therefore seems clear that studies of a quantitative nature which forms the basis of our work cannot be carried out efficiently at Daresbury.

References - 1. L. Holloway, H. Laidler, Submitted to J.Appl. Physics for MMM-Intermag 2001.

2. L. Holloway and H. Laidler, in preparation for J.Appl.Phys.

3. B.E. Warren, X-ray Diffraction (Addison Wesley).

4. P. Dova, H. Laidler, K. O'Grady, M.F. Toney, M.F. Doerner, J.Appl.Phys. 85 (5) (1999) 2775.