LACBED and TEM Study of the Multi-layered Stacking Faults in a Cobalt

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Recently a new methods, using LACBED (Large Angle Convergent Beam Electron Diffraction) for identifying the nature of stacking faults as being either intrinsic or extrinsic, has been reported[1,2]. However in a cobalt, multi-layer stacking faults are commonly observed in fcc phase and could be mistakenly identified as simply an intrinsic or an extrinsic, if only strong beam images are used for the identification[3]. The purpose of this work is to clarify it whether one could make the same mistake, only using the reported LACBED method.

Observations and Simulations: Thin foils of cobalt (in fcc phase, a= 0.354 nm) were examined by a new Philips CM200 (200 Kv) microscope. Fig. 1a shows strong beam dark field images of multi-layered stacking faults. The orientation is close to a (-1 3 4). The diffraction vector, g = (-1 1 -1) is indicated as an arrow in the figure. Fig. 1b and c show weak beam images of the same faults as in Fig. 1a, with the diffraction vector of g with Kx=2g and -g with Kx=-2g, respectively. Fig. 2 show the LACBED patterns near the area marked as a square in fig. 1.

Now analysis of the strong beam images of fig. 1a indicates that the faults denoted as α and β are the same nature of faults as being intrinsic and the γ and δ faults as being extrinsic. But the pronounce contrast differences in weak beam images of these faults, as seen in fig. 2a and b, suggest that these faults including the γ fault have all different natures of complex multi-layered stacking faults. Fig. 3 shows the computer simulated LACBED pattern corresponding to fig: 2, with the model of extrinsic fault. The agreement between these figures is very good. However this does not mean that the γ fault is simple extrinsic. For the models of multi-layered stacking faults (up to about 20 layers as being a microtwin), the computed

LACBED pattern are all similar and can be matched with the observed image in fig. 2. (The simulated strong beam images of these models are all similar to the observed image in fig. 1a too). Therefore it is concluded that the reported methods using LACBED can not be used for identifying the nature of multi-layered stacking faults. However it should be noted that with this method it can be obtained an accurate value of phase shift due to the body displacement of the bottom matrix with respect to the top when bounded by a fault plane.

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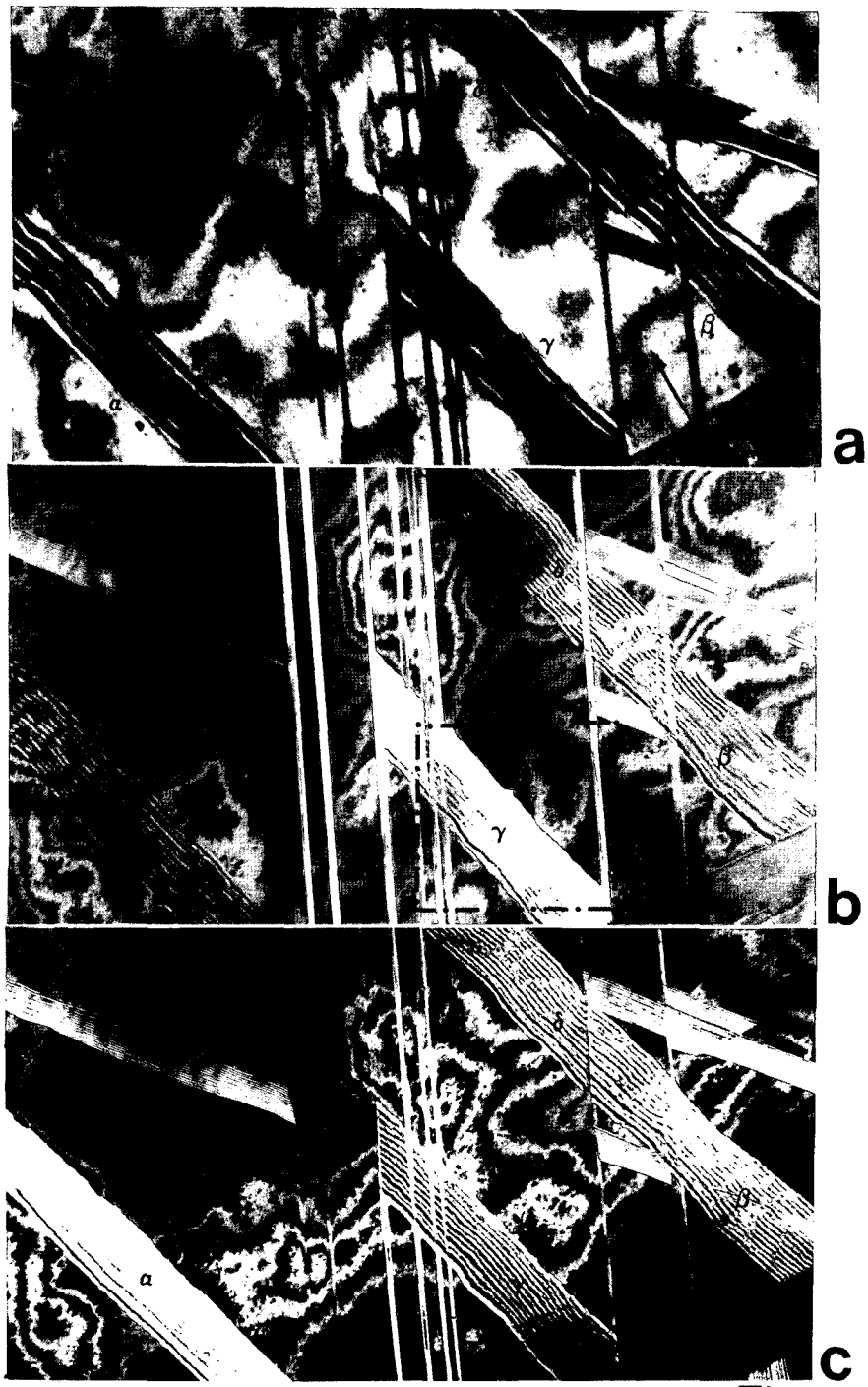

Fig.1

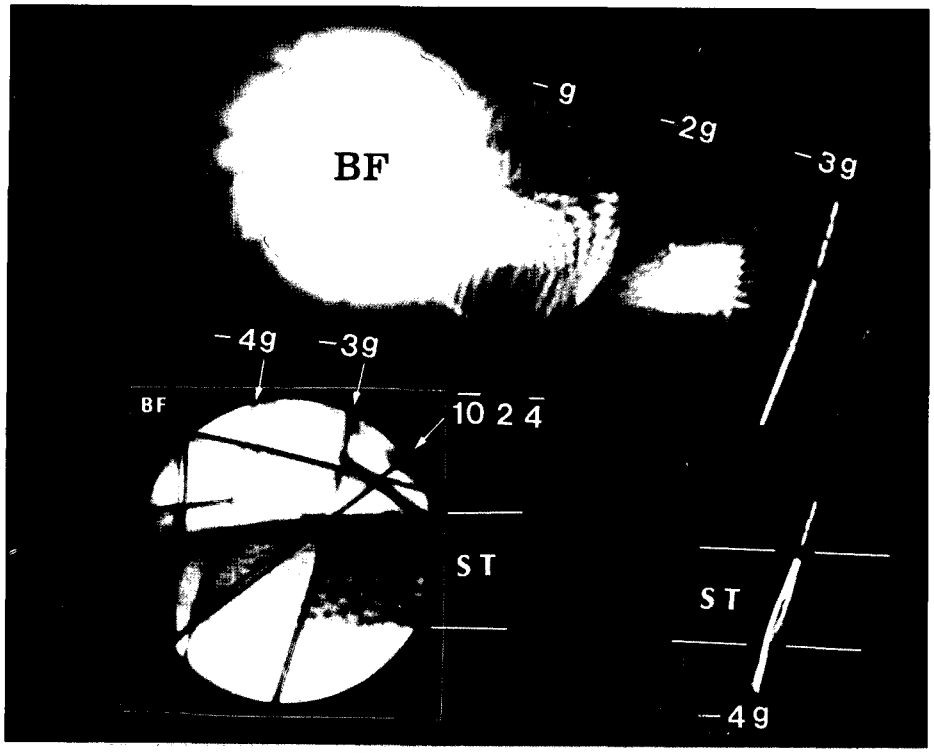

Fig. 2

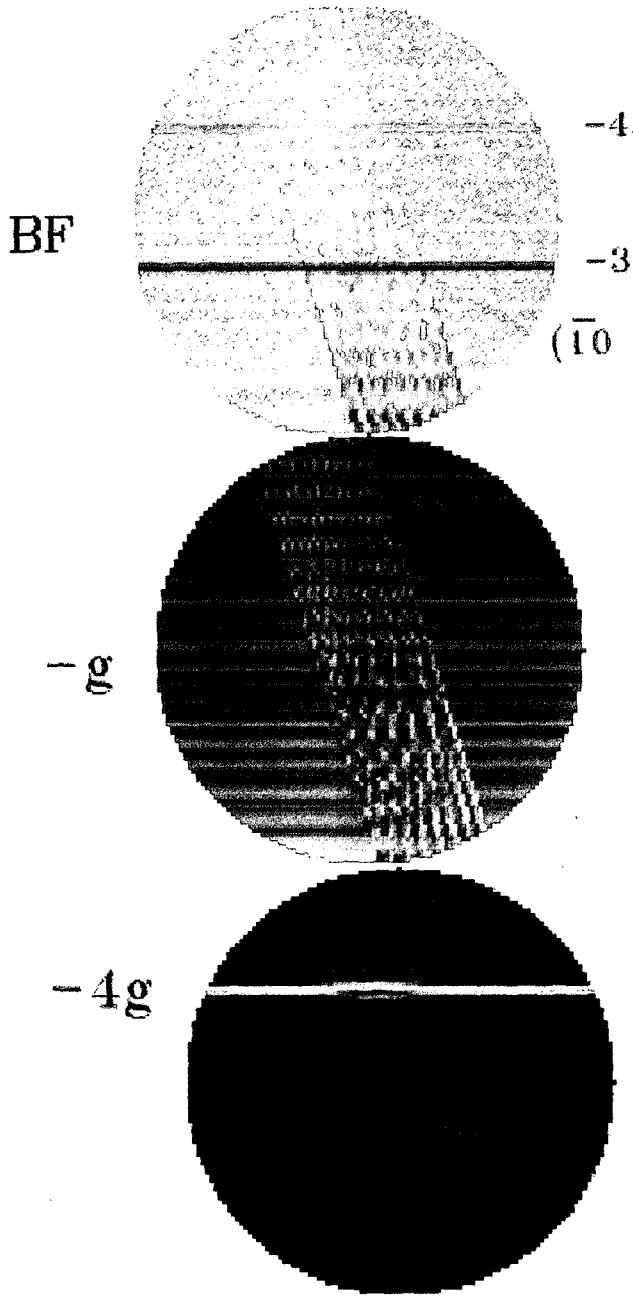

Fig. 3 g=1̄1̄1̄