CHAPTER VI

CONCLUSION AND SUMMARY

6.1. Concluding remarks:

This investigation has elucidated some of the interesting characteristics of the oxide growth on copper. The behaviour of the oxide orientations shows that each copper face in \( \{110\} \) zone has a preferred antiparallel orientation of oxide. Even (110) copper face, so far known to have a strongly preferred parallel orientation is found to have a preferred antiparallel orientation also. These antiparallel orientations are observed to disorient on the corresponding copper faces, when facets are developed on them. This uncommon disorientation effect leads to an outstanding characteristic of oxide, namely that, oxidation is preferentially initiated at the edges on a rough copper face. Pashley (1952) has obtained some evidence to show the occurrence of nucleation at a step in the case of a subsidiary growth of silver bromide on silver. No evidence seems to have been put forth in support of nucleation of growth at any other site of irregularity. It is probably for the first time that a direct evidence in support of nucleation of growth at an edge has been furnished from the electron diffraction studies of oxide.

The other striking characteristic of oxide is its ability to grow in a coherent form on any two adjacent facets of a copper substrate, which also seems to have not been reported so far. Though in some cases of the disoriented oxide
growth in antiparallel orientation, it has not been possible to identify the other adjacent facet, the assumption, that the growth is in a coherent form, is justified from the observed fact that the angle of disorientation varies according to the order of development of adjacent facets. The mechanism, proposed for the nucleation of oxide at an edge clearly indicates that the coherent growth is more or less an enlarged picture of the linear nucleus. The remarkable fact that the contact plane of oxide on a copper facet is different when the coherent growth on it is changed suggests, in agreement with Schulz (1953), that the influence of the orienting surface forces upon the growth practically ceases, when once the nuclei are formed on a substrate. Moreover, it shows in a striking manner the important role played by one dimensional fit in an oriented growth.

6.2. **Summary:**

Nine different faces of single crystals of copper from \(\{110\}\) zone are used in this investigation of oxide orientations. Two copper crystals were cut for each of the crystallographically important \((110), (111), (113)\) and \((001)\) faces and one for each of the remaining. All results which are presented are based on many experiments, each of which has been performed at least thrice and given rise to similar results. For keeping consistency in presentation, the results are given with reference to copper faces in \(\{110\}\) zone. However, they are equally applicable to the faces in any other similar zone. The summary of the work carried out in this investigation
is as follows:

1) The oxide grows in antiparallel orientations on all electrolytically polished copper faces, excepting (110) and (331), on which it grows in parallel orientations. Most of these orientations are verified by two independent methods.

2) On rough copper faces, oxide is found to grow in both orientations.

3) The antiparallel orientations, in general, disorient on rough copper faces and the extent of disorientation increases with the degree of roughness of copper faces.

4) Oxide grows on (001) facet in parallel orientation, instead of its preferred antiparallel (111) orientation, when (110) type facet is adjacently situated.

5) Oxide growth on any two adjacent facets from $\{110\}$ zone occurs in a coherent form in antiparallel orientation, provided the angle between them is suitable for this orientation to occur.

6) The observations given in (3) and (4) indicate that oxide is nucleated at an edge.

7) On the basis of the initial nucleation of the growth at an edge, a mechanism is suggested for the formation of a coherent growth.

8) The contact plane of oxide on a copper facet is shown to change in different coherent growths in antiparallel orientation. This fact indicates the exclusive importance of one dimensional fit in the development of an oriented oxide growth.