

Detection of Imperfections in NaCl Crystals Using Blue Coloration with Electron-Irradiation

Toshio IKEDA and Mamoru BABA

Department of Electrical and Electronic Engineering, Faculty of Engineering,
Iwate University

Summary

We found that blue coloration is produced by electron-irradiation above about 100°C in NaCl crystals. Especially the coloration produced at about 150°C is very sensitive to the presence of some kind of imperfections. It is due to the formation of X centers (or F_n centers) and is sensitized by the presence of divalent cation impurities and OH^- ions. Using this sensitizing effect on the coloration we were able to decorate the distribution of Cd and Mn impurities which were introduced into crystals from the surface by diffusion treatment.

The blue coloration due to the formation of X centers are also found to be sensitized by the introduction of structural defects into the crystals. For example, the slip planes introduced by compressive stress and the rosette patterns introduced by surface indentation were both decorated as the dark blue patterns with electron-irradiation at 150°C. Sub-grain boundaries and dislocation lines were detected as the dark blue coloration due to the impurities selectively precipitated at those regions.

In natural rock salt from Germany, cubic voids, which contain the ancient sea water with some kind of impurities, acted as origins of circular or ring coloration. These patterns were ascribed to the sensitization of coloration by impurities diffused from the void. The sub-grain boundaries in the rock salt were also observed as colored contour lines which are due to the diffusion of precipitated impurities. The synthetic crystal grown from aqueous solution also contains cubic or oblong voids which also include water. However, the coloration pattern due to the diffusion of impurities was not observed. On the contrary, new coloration pattern with small rings were produced by electron-irradiation above about 300°C.

The mechanism by which the various patterns were developed on the crystal surface are discussed in relation to the distribution of impurities and imperfections in each specimen.