S.p.31. PRADEEP, B.–A study of the preparation and characterization of Bismuth Telluride and Bismuth Oxide Thin Films–1987–Dr. Joy George.

In this thesis is reported the preparation and characterization of Bi_2Te_3 films. The bismuth and tellurium flux are approximately 2-3 × 10^{14} atoms $cm^{-2}S^{-1}$ and 3-4 × 10^{15} atoms $cm^{-2}S^{-1}$ respectively. The substrate temperature is in the range 530-545 K. X-ray diffraction studies have shown that these films have no particular orientation on the substrate surface. Electrical measurements show that the films have carrier concentration of 1.2 × 10^{20} electrons cm^{-3} and a mobility of 100 $cm^2v^{-1}S^-$. Thermoelectric power measurements show that these films have a high thermoelectric power of 350 V K^{-1}

A systematic study of the oxidation of bismuth films in different atmospheres like air, super-heated steam, nitrogen, and partial vacuum has been undertaken. The temperature of oxidation is varied from 500 K to 650 K. x-ray diffraction studies have been made of the different films prepared and the different single phase films of ß-Bi_2O_3 (tetragonal), α-Bi_2O_3 (monoclinic), and γ -Bi_2O_3 (cubic) obtained have been confirmed.

Three temperature method was also used here for the preparation of Bi_2O_3 films. Here bismuth is evaporated into an oxygen atmosphere. The impingement rate of bismuth atoms into the substrate surface is varied from 3.5×10^{15} to 5.6×10^{15} atoms cm^{-2} S^{-1}. The substrate temperature is also varied from room temperature to higher temperatures. Only ß-phase films are obtained by this technique.

Films of Bi_2O_3 obtained by three temperature method is of poor quality due to the incorporation of unreacted bismuth in the growing film. Good quality films have been obtained using activated reactive evaporation. As evidence by the x-ray diffraction studies it is seen that at constant oxygen pressure, for low bismuth evaporation rate, ß-Bi_2O_3 and at high evaporation rate α- Bi_2O_3 are obtained. Refractive index, absorption coefficient, and band gap of these films have been determined from the study of optical properties.

Heat mirrors using layers of Bi_2O_3 and gold has been fabricated. Visible transmission and IR reflection have been optimized by varying the thickness of Bi_2O_3 and gold layers. These structures can be used incandesent lamps, where it will increase the efficiency and in glass panes and windows of buildings where it will give better insulation.