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Frozen photoconductivity in PbTe films

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Abstract. We have studied PbTe films of thickness $d=200/10000$ A made with telluride vapour deposition on glass substrate at room temperature. The estimate of the donor concentration $\sim 10^{19}$ cm^{-3} of the fresh-deposited film compared with the impurity content in the bulk raw material $\sim 10^{17}$ cm^{-3} shows that the donors were mainly film defects or non-stoichiometric Pb atoms. Electrical conductivity of the freshly deposited film increased with lowering of the temperature. After deposition the donors were compensated with an oxidation in the laboratory air. Transition to the thermally activated conductivity resulted from oxidation. At temperatures below $T \approx 100$ K the resistance of the compensated films followed Mott's rule $R=R_0 \exp(T_0/T)^{1/3}$. The square film value 1 Mohm and $T_0 \approx 100$ K for $d=1000$ A.

At low temperatures an exposure to light resulted in sharp decrease of the film resistance. At liquid helium temperatures the resistance dropped 10^3–10^6 times and stayed at the low value for an indeterminate time. The heating of the film above $T=100$ K gave rise to an initial high resistive state. The critical temperature T_c, when the frozen photoconductivity became negligible, varied with samples in the temperature region 90–120 K. Near the critical temperature we could measure the time dependence of the film resistance after the light exposure, which followed the equation $R=A+B\cdot\ln t$ for $t>1$ sec with the empirical constants A and B. After a time interval τ the resistance gained the initial "dark" value and remained stationary. The value $\ln\tau \approx \alpha\cdot(T_c-T)$, where the factor α approximately was $\alpha \approx 0{\cdot}5$ K^{-1}.

Some results of these experiments were published earlier (Krylov and Nadgorny 1982; Krylov and Pojarkov 1984).

Keywords. Photoconductivity; PbTe films.

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