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OPTIMIZATION PROBLEMS OF 3-5-COMPOUND PHOTOCATHODES IN THE REFLECTION AND TRANSMISSION MODE

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Abstract. — The basic model of photoemission from p-type 3-5-compound photocathodes with negative effective electron affinity is well established, but there are still some unknown problems. The optimization of the photoemission yield from such photocathodes has to take into account such factors as the surface escape probability of electrons, and the diffusion length of electrons in p-type material.

The escape probability is described in terms of emission over an interfacial potential barrier at the semiconductor surface. Sommer's view of the optimum surface activating layer thickness of caesium oxide, also for low band gap ternary compounds, composed only of some atomic layers was confirmed by ion counting techniques and Auger spectroscopy. The latter technique is also able to detect impurities and decomposition of 3-5-compound surfaces due to preferential evaporation. The diffusion length of the best available p-type material is obviously limited by Auger recombination only at high doping concentrations. Diffusion lengths of 5 to 10 μm are reported for the optimum doping concentration of some 10^{18} cm^{-3}. High transmission mode photoemission was only obtained for multilayer structures e. g. GaP/(Ga, Al)As/GaAs where a transparent intermediate layer of the same lattice constant as the active photoemitting layer serves to accommodate the strain due to lattice mismatch. The step in the conduction band between p-(Ga, Al)As and p-GaAs reduces the interface recombination.