

# NASA TECH BRIEF

*Marshall Space Flight Center*



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## Optimum Doping Achieves High Quantum Yields in GaAs Photoemitters

The doping range resulting in optimum photoemission from GaAs-Cs<sub>2</sub>O has been investigated more extensively. Previously, investigations of photoemission from p-type GaAs-Cs<sub>2</sub>O were confined primarily to materials with an acceptor concentration in the range of  $1 \times 10^{19}$  to  $5 \times 10^{19}$  atoms per cm<sup>-3</sup>. Recently, however, it was shown that, for low work-function surfaces of Cs<sub>2</sub>O, quantum yields as high as those obtained on  $4 \times 10^{19}$  cm<sup>-3</sup> Zn-doped GaAs-Cs<sub>2</sub>O could be achieved in  $2 \times 10^{17}$  cm<sup>-3</sup> GaAs. The photoemission from ultra-high vacuum cleaved GaAs-Cs<sub>2</sub>O was measured in the acceptor density range between  $3.3 \times 10^{16}$  and  $4.6 \times 10^{19}$  cm<sup>-3</sup>.

The data obtained from the experimental investigations clearly indicate that an optimum doping range exists. Measured quantum yield curves indicate that an optimum overall response is obtained in GaAs emitters with doping in the high  $10^{18}$  cm<sup>-3</sup> range. However, the doping for optimum response at a given wavelength is not necessarily in this range, as indicated in the figure where the quantum yield as a function of acceptor concentration is plotted, with wavelength as a parameter. For example, at 9250 Å, the higher the doping level, the better the

response. At 9000 Å, peak response is obtained with GaAs doped in the low  $10^{19}$  cm<sup>-3</sup> range. At 8500 Å, the peak response is obtained in the  $10^{18}$  cm<sup>-3</sup> range.

As a general guideline, for overall optimum photoresponse, p-GaAs material with the highest electron mobility in the doping range between  $6 \times 10^{18}$  and  $1 \times 10^{19}$  cm<sup>-3</sup> should be selected.

### Note:

Requests for further information may be directed to:

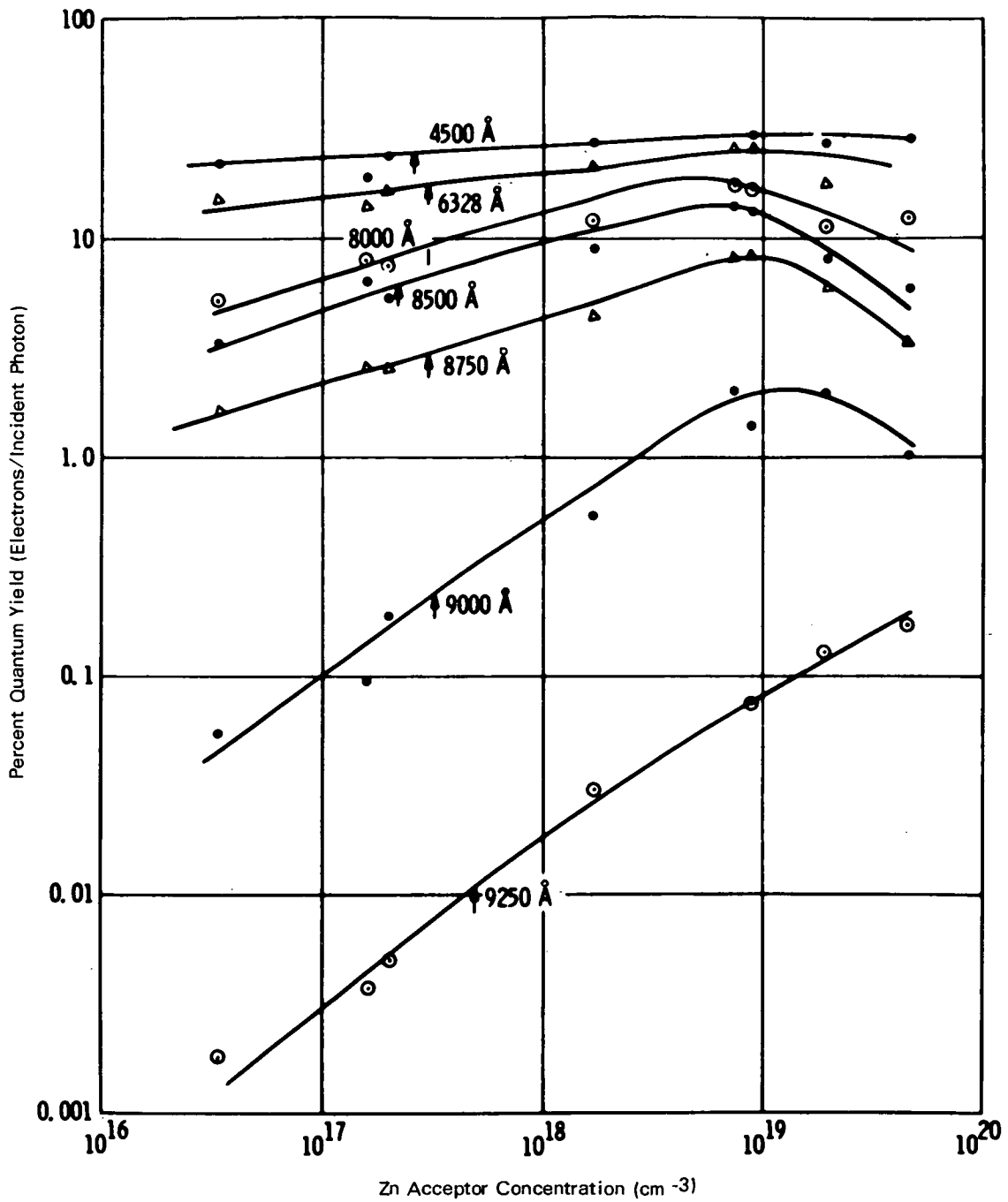
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No patent action is contemplated by NASA.

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(continued overleaf)



Optimum Photoresponse of GaAs-Cs<sub>2</sub>O as a Function of Doping, with Wavelength as Parameter.