

AO-1      PRESENT AND FUTURE TRENDS IN VISIBLE DISPLAYS  
(INVITED)

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The present solid state display market is dominated by GaAsP, with a smaller market segment served by GaP. It appears likely that the technologies of VPE (vapor phase epitaxy) used for GaAsP on GaAs substrates will be combined with LEC (Liquid Encapsulated Czralski) GaP to produce higher performance visible emitters. The use of the GaP substrates supplies a basically transparent medium for the generated light. The overall effect is approximately a ten times improvement in luminous efficiency for red emitters. The chip design for good luminous efficiency with the transparent substrate will be discussed. High performance red and yellow GaAsP on GaP substrates have been produced.

The use of III-V material in display has required adequate cost reduction to be competitive with other technologies. This cost reduction has been achieved by cost reduction of starting material as well as package innovations to obtain more display digits per square centimeter of material. For small portable calculator use, the method has been to use individual magnifiers over each digit in an array. The most effective manner of obtaining more large display digits (8-16 mm in height) per square centimeter of starting material is the use of point to segment converters. In this case, the source of light is a small diode, typically 250 micron diameter. By using such optical effects as magnification,

reflection, and light diffusion, satisfactory bar segments can be obtained. Some of the schemes that have been used for such optical effects will be discussed.

In some applications, display other than red is desirable. Good on-off ratios of brightness are easily obtained in red display by using a long wavelength red filter to absorb almost all but the emitted light. The use of yellow or green chips in the display package requires more lumens as well as a somewhat more complicated package for adequate ON-OFF contrast. The specific optical methods to enhance yellow and green display will be discussed.

Finally, the comparative advantages of various materials technology and packaging combinations will be discussed, and directions of development will be indicated.