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IV - VI Narrow Gap Semiconductors and Devices

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Most of the IV-VI compounds are direct semiconductors with a small energy band gap $E_g \lesssim 0.3$ eV. E_g can, however, be adjusted by forming solid solutions and shifted via the dependence of E_g on temperature, pressure and magnetic field. This makes these compounds interesting for optoelectronic devices operating in the infrared spectral region. Tunable injection lasers emitting between about 2 and 20 μm and photovoltaic detectors, sensitive around 10 μm, are of particular practical importance.

The paper reviews the device preparation techniques and corresponding properties emphasizing industrial fabrication requirements. Therefore, technologies for reproducible production of large, perfect single crystals and high quality pn-junctions are discussed on the basis of the most developed binary (PbS, PbSe, PbTe), and ternary ($Pb_{1-x}Sn_xTe$, $Pb_{1-x}Sn_xSe$, $PbS_{1-x}Se_x$) systems. In the authors opinion, vapour growth of bulk crystals, molecular beam epitaxy and ion implantation are promising techniques for this purpose.

The various laser structures are briefly described. Since for most applications low threshold currents and high operation temperatures are desirable, the paper deals mainly with the state of double heterojunction lasers. Moreover, their tuning by temperature rise during current pulse is favoured as the most economic solution.

A comparison of different detector structures (e.g. Schottky diodes, implanted and epitaxial junctions) will be given. Recent results on their detectivity are summarized, supplimented with data obtained from array structures and compared with those of competetive III-V and II-VI compounds.

Finally, applications will be reviewed for lasers and detectors illustrating their practicability. The combined use of both devices in gas spectroscopy for the selective optical detection of air pollutants is one of our projects in this field.