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Sb/InP: control of Schottky barriers by adsorbed layers

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Abstract. Studies of electrical barrier heights at Sb contacts to clean and oxidised n-InP, using XPS and transport techniques, demonstrate that the barrier heights can vary between Ohmic and about 0.8 eV depending on the precise condition of the InP surfaces.

Most metals when deposited on n-type clean cleaved or air-exposed indium phosphide crystals lead to Schottky barriers in the range 0.3 to 0.55 eV. However, it has recently been found that thick antimony contacts deposited on atomically clean cleaved (110) surfaces pin the Fermi level close to the conduction band yielding highly Ohmic low-barrier contacts on n-type material and high barriers on p-type material. However, we have found that barrier heights of around 0.7 to 0.8 eV can be achieved for Sb on (100) n-InP provided the surfaces are first chemically treated as follows: (i) mechanical polishing followed by etching for $1\frac{1}{2}$ min in 0.1% bromine in methanol; (ii) etching for 2 min in bromine water; (iii) rinsing in methanol followed by drying in N_2. The clean and

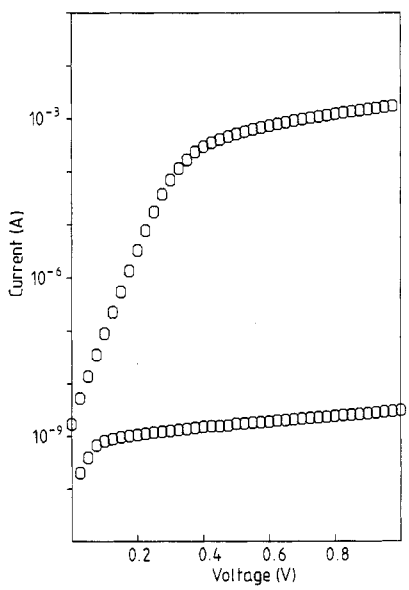

Figure 1. Current against voltage for Sb/n-InP(100) (etched).

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etched surfaces have been investigated by high-resolution XPS. These studies confirm that the Fermi level at the n-type surface is shifted considerably for the oxidised surface compared with the clean surface, and is consistent with an oxide-induced pinning about 0.5 eV below the conduction band edge. Following Sb deposition, a further shift of 0.2 eV indicates a Schottky barrier height of 0.7 eV consistent with transport data (figure 1). Detailed investigations of the nature of the oxide layer have been carried out. Finally we mention that the diodes formed for Sb on the oxidised InP surface are rather unstable and deteriorate with time.