materials in homogenous form. Alloys of II–VI composition, such as (Hg,Cd)Te with approximately 80 per cent HgTe, do have the required low bandgaps, which is why they have been studied intensively. But another requirement for the infrared material is that the bandgap value should be very uniform across the wafer, so that most of the individual photovoltaic detector elements can function properly. For this reason it will be necessary to control (Hg,Cd)Te compositional variations to much less than 1 per cent over large areas. This requirement is very difficult to meet with existing growth techniques, causing concern about the yield of devices based on (Hg,Cd)Te alloys and their cost. Materials for infrared detection must also be stable and able to survive severe conditions at some processing steps and harsh environments in operation. Their bond strengths are generally low because of the large atomic numbers of the constituent atoms. (Hg,Cd)Te is particularly brittle on this account and because of the significant ionic component of the bonding.

Although the bandgaps of homogenous III–V alloys are larger, In(As,Sb) SLSs are expected to have the desired 0.1 eV value[1]. This comes about because of the alterations of layers in compression and tension; the larger layer strains needed to accommodate the differences in atomic spacing of the SLS layers act to reduce the bulk bandgap of those layers in the III–V SLS which are in tension. SLSs with layer strains greater than or equal to 0.5 per cent can show strain shifts which are enough to bring the gap of the In(As,Sb) alloy with the lowest gap value (60 per cent InSb) down to 0.1 eV at 77 K.

In(As,Sb) SLSs are expected to have some valuable features for detector arrays. For example, their bandgaps are fairly insensitive to compositional variations in the per cent range. Such variations in the In(As,Sb) layer compositions across the SLS wafer should be tolerable for detector applications. Moreover, it is expected that the III–V In(As,Sb) SLSs will have greater bond strengths than the (Hg,Cd)Te alloys suitable at long wavelength because of the larger covalent contribution to their bonding.

Some of these predictions have now been put to the test following the first successful growth of In(As,Sb)-based SLSs[2-4]. X-ray diffraction and transmission electron microscopy studies have verified the presence of the alternating SLS layers, and bond strengths in these materials seem sufficient to allow the growth of the thin superlattice layers at temperatures of 400–500°C for several hours without any large-scale interdiffusion of the layers.

Typical overall structures consist of InSb substrates (a few hundred microns thick); an $InAs_{1-z}Sb_z$ 'buffer layer' which is first grown on the substrate; and finally a superlattice (~1μm thick) which consists of many thin alternating strained layers of $InAs_{1-x}Sb_x$ and $InAs_{1-y}Sb_y$, where x and y are different.

Defects are a problem. The buffers typically contain many lattice defects. In previous SLS studies with larger bandgap materials, it has been found that the strained layers prevent buffer defects from penetrating through the superlattice, but initial electron microscope studies surprisingly show this not to be the case for the In(As,Sb) SLSs. Indeed, many buffer defects are seen to propagate through the SLS, and will hamper detector function unless they can be eliminated.

The reasons for the prevalence and persistence of these defects are not yet established, but the main focus of current work on In(As,Sb) SLSs is to eliminate buffer defect propagation. Some approaches include the use of graded composition buffers; buffers with less mismatch relative to InSb; or alternative substrates with buffers in compression.

Meanwhile, attention continues to be focused on the (Hg,Cd)Te alloys. One promising approach is to use superlattices made of alternating layers of the II–VI binaries HgTe and CdTe[5-7], which have been shown to have the desired bandgap value. One advantage of this system is that bandgap variations across the superlattice wafer arise only from layer-thickness variations which can be very precisely controlled in growth by molecular beam epitaxy. The most serious difficulty in the approach is that there may be significant layer interdiffusion even at the very low growth temperatures (185°C) used[8]. Thus, superlattices in the (Hg,Cd)Te system are likely to be similar to the (Hg,Cd)Te alloys themselves with respect to stability during device processing and in harsh environments.

The recent trend in infrared materials research has been in the direction of artificially layered structures and new layer materials. The new-found flexibility in designing and controlling the properties of novel superlattice materials promise to help in meeting the difficult requirements for infrared focal plane arrays. But the physical properties of these layered materials are interesting in themselves and so may well provide further possibilities. ☐

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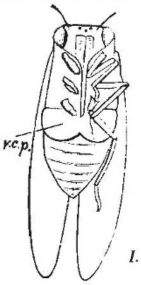
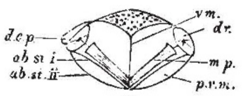
NATURE

100 years ago

The Singerjie (*Platypleura capensis*) is a well-known insect at the Cape; and few visitors to the shores of Table Bay can have failed to notice, in the hotter months of the year, the sharp shrill metallic sound produced by the "little singer." The male Cicada alone possesses the power of singing, the female — recognised at once by the long ovipositor folded beneath the abdominal somites — being dumb. If the ventral surface of a male singerjie be examined (Fig.I.) two large ventral cover plates (*v.c.p.*) are seen meeting in the central line and extending backwards from the metathorax over the anterior abdominal somite. On turning the insect over and looking at the dorsal surface, two very much smaller dorsal cover plates are seen extending forward from either side of the first abdominal somite. If one of these plates be removed there is seen the wrinkled surface of a thickish chitinous membrane, the drum. Turning the insect over again, and removing one of the ventral cover plates, two membranes are disclosed, separated by a transverse chitinous support. Of these the anterior is white, narrow, and opaque, the posterior (*p.r.m.*, Fig. II.) translucent, oval, and tightly stretched.



I.



II.

The transverse chitinous support (*ab.st.* ii) is the sternum of the first abdominal somite; the membranes would seem to be modified to act as resonators. The second ventral cover plate may now be removed, disclosing the anterior and posterior resonator membranes; the anterior membranes may be cut through; and the abdominal portion of the insect may be separated from the thorax. There are seen, taking their origin from the mid-line of the first abdominal sternum (Fig II., *ab.st* i), two muscular pillars (*m.p.*), each of which, terminates in a chitinous plate, the upper surface of which is connected by a fine ligament with the drum (*dr.*). Under a low magnifying power this drum is strengthened with brownish ribs, which, together with its general elasticity, cause it to spring back after it has been drawn forward by the action of the muscular pillars, the fibres of which are beautifully striated. Each time the drum is drawn forward and springs back, by the alternate contraction and relaxation of the muscular pillars, a sharp click is heard, as may readily be proved experimentally on the dead insect.

From *Nature* **33** 369, 18 February 1886.

Erratum

In Frank Westheimer's article "Polyribonucleic acids as enzymes" (*Nature* 13 February, p.534), figures 1 and 2 were transposed although the legends were correct.