reasonable to suppose, therefore, that the increase in dark conductivity is determined by the number of mobile positive holes left when the excited electrons are trapped. Thermo-electric power measurements confirmed that the conductivity was due to positive holes.

The sensitization spectrum was found to be very similar to the photoconductivity spectrum of free sulphur. In view of the conditions of preparation, it is likely that specks of free sulphur exist in the layer; and hence the sensitization process entails the raising of electrons from the filled band of the sulphur crystals into the conduction band, from which they are afterwards trapped.

There is no completely satisfactory explanation of the rise and subsequent fall in cell sensitivity as sensitization proceeds. It is analogous to the variation in cell sensitivity found during the manufacture of normal lead sulphide cells as the layer moves from an excess to a deficit semiconductor[2]; but it is curious that the point of maximum sensitivity does not coincide with a point of maximum dark resistance. The time constant of the cell (defined as the time taken for a signal to decay to $1/e$ of its original value) also passes through a maximum at about the same time as maximum sensitivity is reached.

The spectral response of the cells moves to longer wave-lengths during sensitization, the spectral limit reaching about the value found for normal lead sulphide cells at 90° K. when maximum sensitivity is reached[5].

The above work was carried out in the laboratories of the Telecommunications Research Establishment, Great Malvern, and thanks are due to the Chief Scientist, Ministry of Supply, for permission to publish this note.

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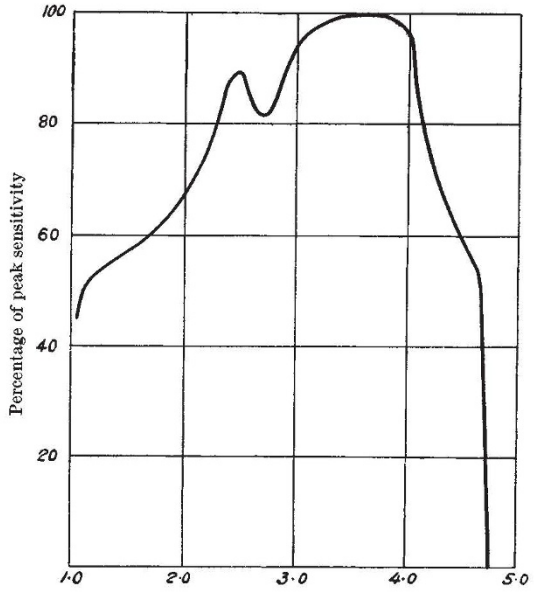
Lead Selenide Photoconductive Cells

The superiority of lead selenide photoconductive cells over lead sulphide cells and over purely thermal infra-red detectors in the 3–4 μ region has already been described[1,2]. The preparation of these sensitive layers has always been by an evaporation method[3,4] analogous to that previously used for lead sulphide[5]. Chemical deposition processes[6,7] for the preparation of lead sulphide cells have been further developed by us, until comparable sensitivity at room temperature and greater sensitivity at low temperatures than those obtained with evaporated cells are available.

We have recently made successful trials of a chemical process for preparing lead selenide layers, based on information about a process tried with unknown results by Sommer in Germany[8]. A thin film of lead sulphide is first deposited on the cell blank to act as a seed layer for the growth of the lead selenide microcrystals. This film is prepared by a short immersion in a bath of lead acetate and thiourea, while this is gradually made strongly alkaline. The lead selenide is then deposited on this seed layer from a bath of lead acetate and seleno-urea; this reaction is much slower than the lead sulphide deposition and usually requires about an hour to develop a sufficiently thick layer of lead selenide. The lead selenide film is then subjected to a partial oxidation by baking in air to about 300° C. for 10–15 min.



The sensitivity of these lead selenide cells when cooled with liquid air is such that a signal equal to noise is obtained for 10^{-8} to 5×10^{-9} watt/mm.^{2} of 200° C. black-body radiation, 800 c./s. interruption frequency with 30 c./s. band-width. A typical spectral distribution curve at liquid air temperature is shown in the accompanying graph. It will be observed that this type of lead selenide cell has a broad maximum at 3–4 μ, in this respect resembling the cells reported by Starkiewicz[4]. The position of the long-wave cut-off could not be exactly determined owing to the use of fused silica windows, which absorb strongly in the 4·5–5 μ region; good sensitivity, however, exists up to at least 4·6 μ.

These cells have so far only exhibited appreciable sensitivity at low temperatures, such as those of solid carbon dioxide and liquid air. The investigation is, however, still in an early stage, and these preliminary results are encouraging.

We desire to thank the directors of the British Thomson-Houston Co., Ltd., for permission to publish this note.

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