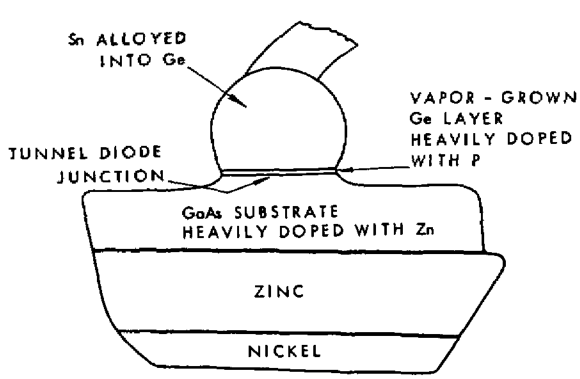
Vapor Growth

Foreword to papers in this issue

The properties of crystalline germanium and silicon are better known and understood than those of other crystals as the result of the intensive scientific and technological studies devoted to them following the invention of the transistor. In spite of the breadth and extent of these studies, the preparation of single crystals by means other than solidification from the molten state has until recently remained relatively unexplored.



In this issue will be presented various aspects of another process of crystal formation—the epitaxial growth of single crystals of the elemental semiconductors by the disproportionation of their halides on crystal seeds at temperatures much lower than their melting points. This process has been named simply *vapor growth.* Capable of producing crystals equivalent to melt-grown ones, its applicability to the preparation of semiconductors is wider than has been generally appreciated.

In the case of the elementary semiconductors, the atoms adding to the growing crystals are supplied from the di-iodide vapor according to the reversible reaction:

$$2XI_2 \rightleftharpoons XI_4 + X\downarrow$$

and so the atoms are supplied from a source quite different from that present in either the growth of a crystal from its molten phase or from its own vapor phase. The perfection and composition of vapor-grown crystals are the subject of several papers in this issue.

Although these aspects of the process are of interest in their own right and deserve more study, the potential applications of the method seem even more interesting and important. Since the crystals can be grown and doped with impurities at temperatures at which atomic movements are negligible, and since the impurity content of the vapor above the growing crystals can be changed rapidly, it is possible to build into them almost any desired impurity distribution. The work reported here on variable-capacitance diodes and on ordinary and degenerately doped junctions illustrates the application of this principle in a given host lattice. In certain cases, even a change in the nature of the lattice to that corresponding to a different element or compound is possible, as is made clear in the paper on heterojunctions. The low temperature of growth makes practical the use of masks to form the desired devices either singly or in arrays.

The work reported here has been carried out at the laboratories in Poughkeepsie and Kingston.

G. R. Gunther-Mohr