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A Laboratory Apparatus for Single Crystal Preparation by Czochralski Method

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The rapid development of the application of semiconductors has stimulated extensive investigations of single crystal growth from a melt. Czochralski method has proved to be the most suitable for that purpose, and therefore it has been mostly studied and developed^{1,2}. In the present communication a simple laboratory apparatus for »crystal pulling« is described. The apparatus can be used not only for growing single crystal of germanium but also of other materials with relative low melting point and convenient crystallization properties.

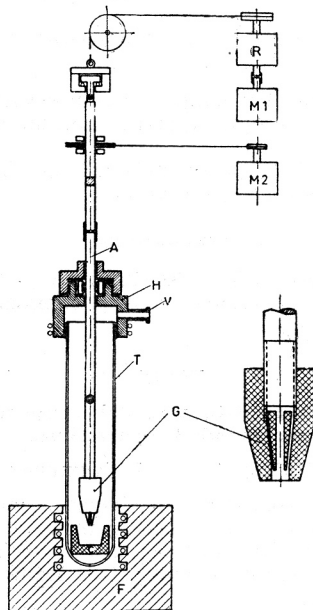


Fig. 1. A steel axis, C crucible, F electric resistant furnace, G graphite holder, H brass head, M1 and M2 electric motors, R rate reducer, T quartz test tube, V connection to a vacuum system.

The apparatus (Fig. 1) consists of a quartz test tube (T) 300 mm. long and 50 mm. in diameter. At the top of the test tube there is a brass head (H), cooled with water or compressed air, and sealed with picein wax. Through the brass head passes a steel axis (A), which serves for pulling the single crystal with simultaneous rotation. Vacuum sealing of the axis is achieved by means of two rubber seals. At the lower end of the axis a graphite holder (G) is screwed to which a seed can easily be attached. The upper end of the axis is connected to a mechanism for crystal pulling, which consists of an electric motor (M 1) and rate reducer (R). The later is adjusted so as to vary the rate of pulling from 5 to 150 mm. per hour. The electric motor (M 2), whose speed can also be varied, turns a belt pulley fixed on the axis. In this way the rotation of the crystal is made possible during its growth, which is very important for achieving the uniformity of its properties. The single crystal thus obtained is cylindrically shaped, which considerably facilitates its further treatment. The whole apparatus is connected through a tube (V) to a vacuum system (rotary or diffusion pump) so that the crystal can be grown *in vacuo* if necessary. The material used to prepare single crystals is usually melted in a graphite or quartz crucible (C). The melt is heated by means of a well-isolated electric resistant furnace (F) of 1100 W, the control or regulation of temperature being performed through a Pt-Pt,Rh thermocouple by means of a separate instrument.

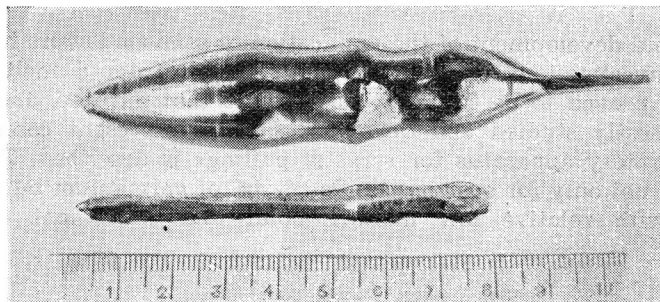


Fig. 2. Single crystals of germanium (above) and zinc (below).

In the apparatus described germanium single crystals of about 200 grams can be prepared. Fig. 2 represents a single crystal of germanium (above) and zinc (below), obtained in this apparatus.

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REFERENCES

1. J. Czochralski, *Z. physik. Chem.* **92** (1918) 219.
2. N. B. Hannay (edit.), *Semiconductors*, ACS Monograph Series, Reinhold Publ. Corp., New York 1959., p. 87.

IZVOD

Laboratorijska aparatura za dobivanje monokristala po metodi Czochralskoga

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Izrađena je jednostavna laboratorijska aparatura za dobivanje monokristala iz taline po metodi Czochralskoga. Opisani uređaj može se upotrebiti za uzgoj kristala različitih materijala sa relativno niskim talištem i povoljnim svojstvima kristalizacije.

Aparatura omogućuje dobivanje monokristala težine do 200 grama. Priređeni su monokristali germanija i cinka.

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