LABORATORIJSKE BILJEŠKE LABORATORY NOTES

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A Press for Electric Resistivity Measurements of Powders

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In research work on semiconductors, the electric resistivity measurements are very important. In most cases it is impossible to obtain a compact sample and the measurements have to be done on the powdered material. For this purpose the resistivity is measured on a sample which is obtained by pressing the powder to a definite pressure between two electrodes.

Our device for pressing is a modified and simplified press, described previously by Brentano and Goldberg[1]. The press is hand-operated (Fig. 1, H), and the pressure actually used can be read on the gauged manometer (M), which also transfers the pressure directly to the piston (B). The calibration of the manometer was performed by gauging it with a standard testing machine at 400, 600, 800, 1000 and 1200 kilos. These forces correspond to actual pressures of 2000, 3000, 4000, 5000 and 6000 atms, since the cross section of the piston at the lower end is 0.20 cm^2. A sample of the finely powdered material is placed in the cell (A), which is electrically insulated from the pressure piston by means of a cylinder (C). By means of the nonius (D) the actual thickness of the pressed pellet can be read to ± 0.05 mm. A heating coil is built into the body (E) of the press, so that the resistivity measurements can be performed at different temperatures. The temperature is controlled by means of a thermometer which is placed in the hole (T). During the measurements the press was attached to a Siemens RLC 7 bridge and the electric circuit was closed over the cell (A) and the piston (B). The measuring bridge was supplied from the mains (220 ± 2 V, 50 cps), a magic eye being used as zero-indicator. Resistivity measurements can also be carried out at different frequencies with an additional oscilator.

The total relative error of specific resistivity determinations is estimated about 14%, since the relative errors in measuring length (l), resistivity (R), and cross section (q) of the sample are 10%, 3% and 1% respectively, provided that the cross section of the piston and the pellet are equal. The most accurate results were obtained for thinner pellets (less than 0.5 mm). In the case of thicker pellets the dissipation of the powder in the circumference causes a larger error, due to the difference between the measured and the actual cross section of the pellet. The larger the ratio of the cross section to the thickness of the pellet, the higher the precision of the measurements. The accuracy of the measurements was checked on several samples of germanium and silicon, of which the specific resistivity had previously been measured by four probe

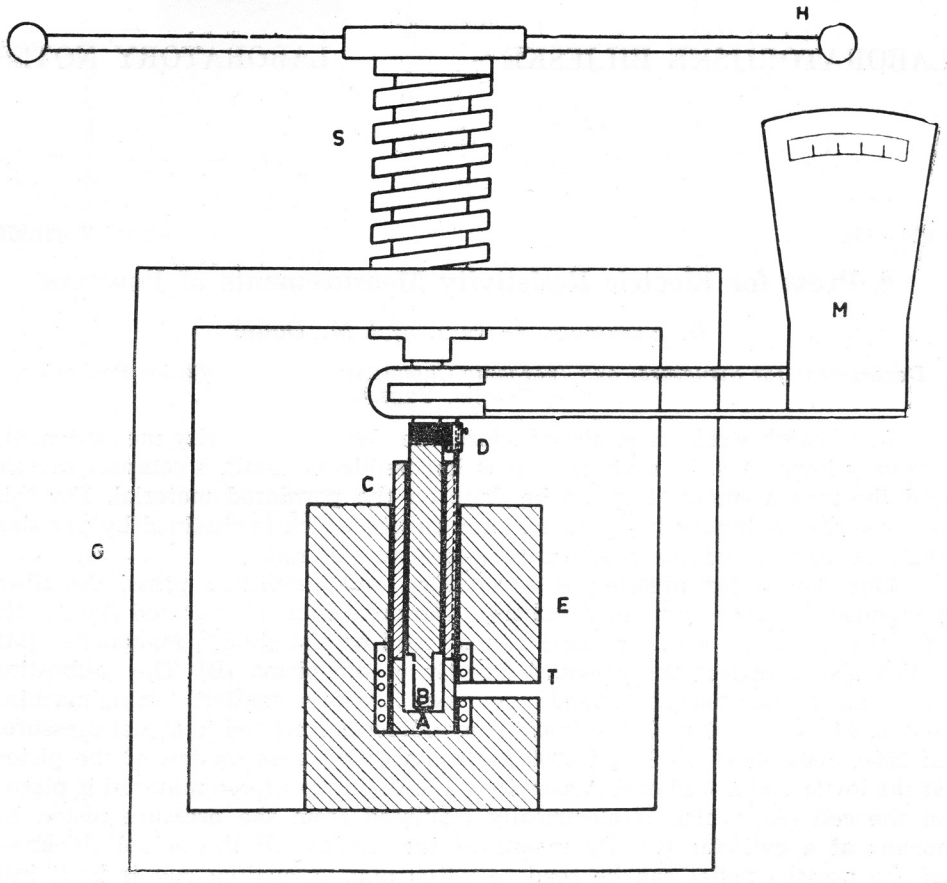

Fig. 1. A cell, B piston, C insulating cylinder, D nonius, E body of the press, G steel frame, H hand grip, M manometer, T hole for the thermometer.

and two probe methods. The relative error in the measurements performed was about 20%. The result was also verified by melting the powdered sample, after its resistivity had been measured, into a solid block, the resistivity of which was determined once more. The agreement of the results obtained was satisfactory. A certain influence of moisture on the results of the measurements cannot be fully neglected. A large number of measurements on complex cyanides of the Prussian blue type[2] and on powdered silicon[3] have been carried out with this press.

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IZVOD

Preša za mjerenje električnog otpora prašaka

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Izrađen je uređaj za mjerenje električnog otpora polikristalnoga praška semikonduktora metodom prešanja između dviju elektroda do pritiska od 6000 atm. S obzirom na griješke mjerenja presjeka i dužine uzorka te električnog otpora, ukupna relativna griješka određivanja specifičnog otpora iznosi oko 14%. Najtočniji rezultati mjerenja električnog otpora dobiveni su kod pastila tanjih od 0,5 mm. Preša je ispitana na većem broju uzoraka germanija i silicija, kojima je specifični otpor prethodno određen u kompaktnom stanju. Relativna griješka tih mjerenja iznosila je u prosjeku oko 20%. S opisanim uređajem izvršeno je više mjerenja specifičnog otpora kompleksnih cijanida tipa berlinskog modrila i polikristalnog praška silicija.

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