POSSIBLE USE OF MICROCABLES FOR THE ASSEMBLY OF MICROSTRIP DETECTORS.

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Abstract

We present here some cosiderations on the use of microcables for the coupling of detectors and electronics. We also shortly discuss the technological sequence of detector assembly and the possible use of a matrix of external resistors for the detector biasing.

1 Proposals on assembly of silicon mocrostrip detector

The design of double-sided silicon microstrip detector (figs. 1, 2) contains, on each side of silicon plate, a row of sensors multichannel preamplifiers and multilayers made on single chips according to BICMOS technology. Up to 8 chips, each of which has 64 input channels and a number of output ones, may be located in a row on one detector with approximate chip dimensions of 5×6 mm^2.

As one for the possible variants of detector assembly it is suggested to use multilayers stub microcables free from wire bonding.

For the purpose of increasing the structure strength and simplifying the installatin work it is proposed to manufacture the connection of chips with strip detector and external recording units with the help of the same flexible microcable with different zones of bonds on general polymer basis, intended for mounting on strip-detector, chips and external units.

The proposed structure of this block is shown in fig. 1. Berillium (Be) shield with chips of preamplifiers are located on the detector. Single of multilayer cables, made of foiled Al-polyamide dielectric with a protective varnish coating and located on chips, connect the latter with detectors and with external units. Aluminium conductors of a cable are welded to chip and detector pads through the windows in polymer basis. Connection with external units is either through welding or soldering, when a solder coating is deposited on cable pads.

Due to elasticity of cable, an unspecified positioning of the cable in space which is required by structure, providing a reliable connection of bonds in different planes is possible, including mutually perpendicular ones.

Use of a cable allows to decrease the amount of welded joints compared to the design with wire bonds. Besides, due to the fixed position of a cable bond the problem of their alignment with pads of chip and detector, is simplified. Pitch of pads on detector and

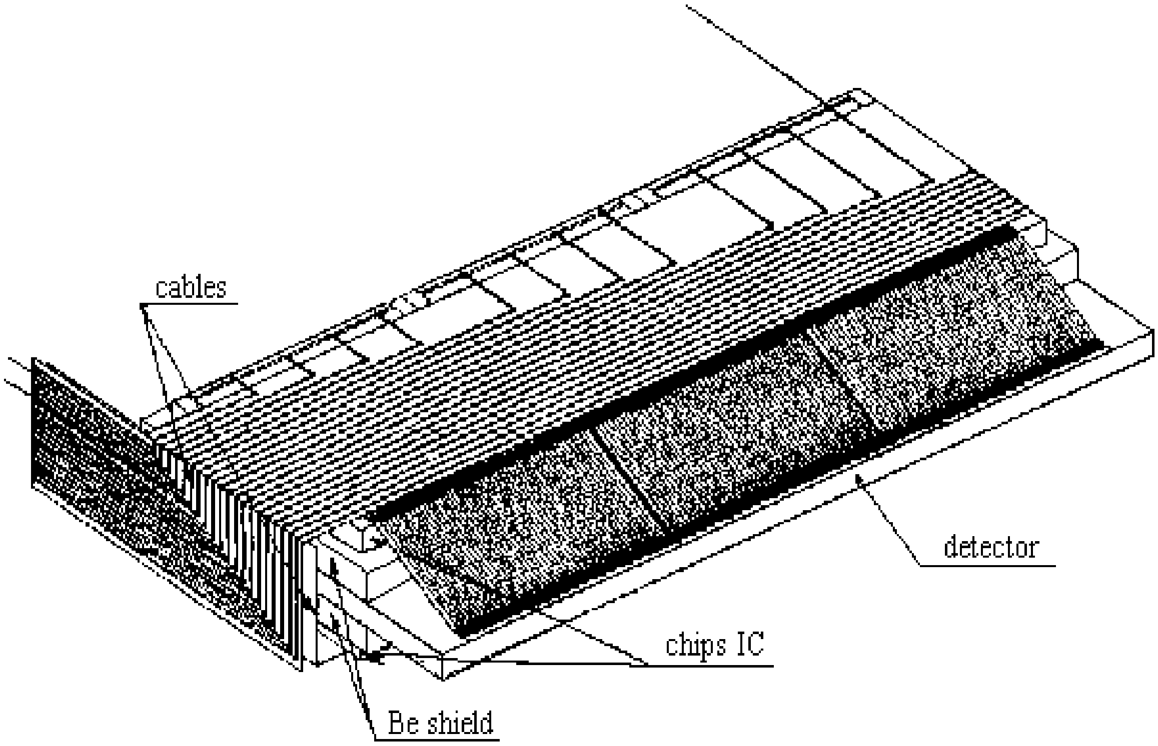

Figure 1: Double-sided silicon microstrip detector

chip may be 100 micrometers. In case of additional research it is possible to provide cable assembly with 50 micrometers pitch.

A cable may consist both of one and more layers, having enough elasticity. Preliminary (before welding) adhesion of the cable to chips and detector allows to unload the welded joints from possible mechanical loads, taking place during the manufacture, and, correspondingly, to increase the reliability of connections. It is particularly important for double-sided detectors because, in this case, the mounting and assembly are carried out on both sides of the detector and the probability of damage increases. Positioning of the cable above the chips allows to decrease Be shield dimensions and that accordingly decreases shield area of detector, which remains equal to the total area of chips.

The suggested design shall enable to carry out consecutive assembly of chips on cable and test all necessary parameters of chips until final mounting on the detector which shall allow a decrease in the amount of adjustment and repair work.

The possibility of cable splicing both by welding and by soldering, will allow to fulfil the successive assembly and testing of modules which contain several strip-detectors. The cable allows repeated bend up to 90^o angle with radius 1-5 mm. Absence of heavy metals in cable design allows to provide quite high radiation resistance and, accordingly, long-term operation.

Proposed design and it's technology is described in details in (3-7). Sequence of detector assembly of proposed design is the following:

- manufacturing the cable single layers;

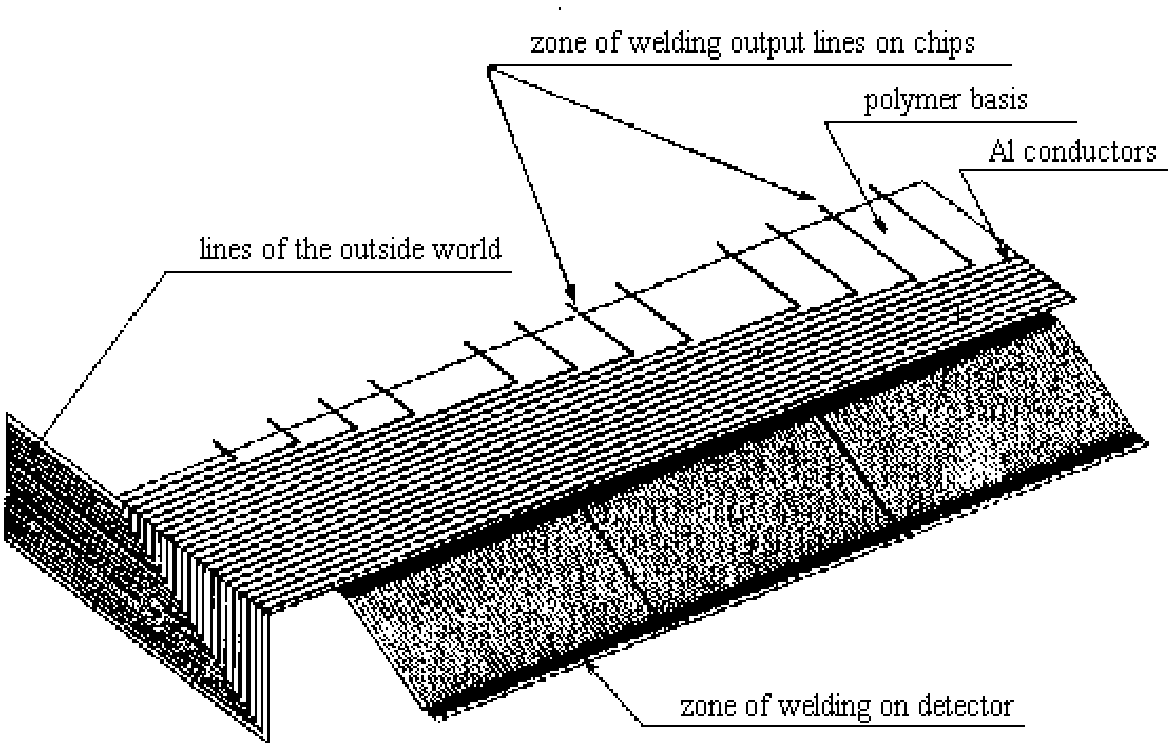

Figure 2: Cable for microstrip detector

- assembling the multilayered cable;
- adhesion, welding and testing the chips;
- mounting the chips with cable on Be shield;
- fixing Be shield to the plate with detectors;
- adhesion and welding the cable to detector pads;
- testing the detector;
- assembling the module out of several detectors.

Therefore, use of flexible cables will allow the following advantages of proposed design of a strip-detector:

- to increase the mechanical strength;
- to reduce the amount of welded joints and to increase the reliability of welded joints;
- to decrease the detector ares shielded by Be shield;
- possibility to test the chip before the final mounting on the detector and test separate modules;
- to simplify the mounting and assembly.

Cable specification, which may be designed and manufactured at NITIP, are shown in the table.

Parameters	Units of measurement	Value
Thickness of polymer basis	mm	0,010...0,040
Thickness of conductive layer	mm	0,010...0,040
Thickness of protective coating	mm	0,002...0,040
Number of layers		1...10
Material of conductors		aluminium (copper)
Material of pads		aluminium (copper, solder coating)
Minimum size of element in layer	mm	0,050
Minimum spacing between element in layers	mm	0,050
Electric strength of polymer basis	kV/mm	50
Bulk electric restiveness of polymer basis	Ohm/cm	10^{14}
Linear mass of cable (singlelayer cable per 20 conductors)	g/m	1,4
Linear resistivity of conductors with width of 100 micron	Ohm/cm	4
Method of cable splicing		adhesion, welding, soldering
Limited temperature of operation	^{o}C	-196...+250

2 Mounted bias resistors

Bias resistors for silicon strip detectors are supposed to be made according to thin-film hybrid technology on separate dielectric boards and to be connected with diod structures of detectors by means of stub microcables.

Fig. 3 shown the design.

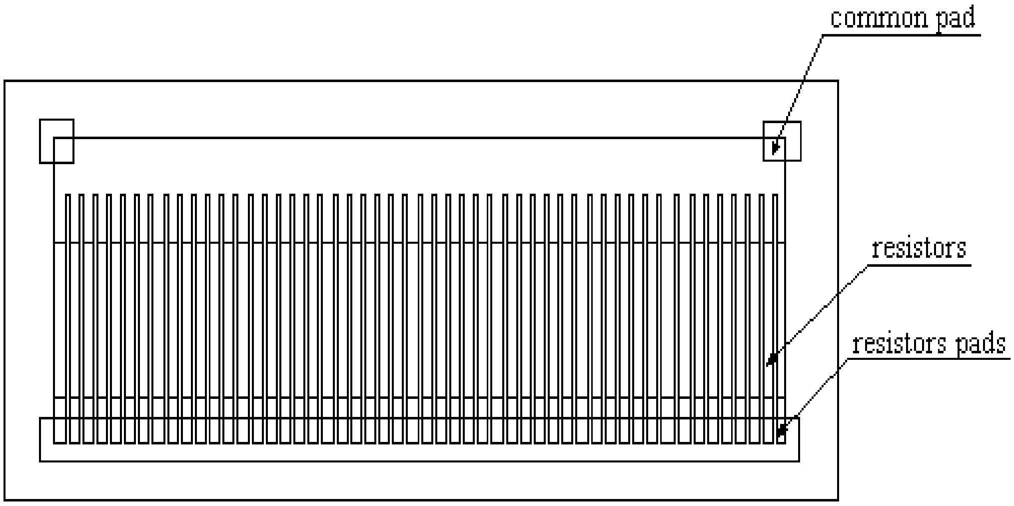

Figure 3: Bias resistors

Possible specification:
- board material .... glass ceramics
- board size, mm .... $2{,}0\times50\times0{,}6$
- number of resistors 500
- resistor spacing, m 100
- resistor resistance, MOhm 1,0
- resistance tolerance per cent 10
- spread detector to detector 10%
- spread strip to strip 1-5%

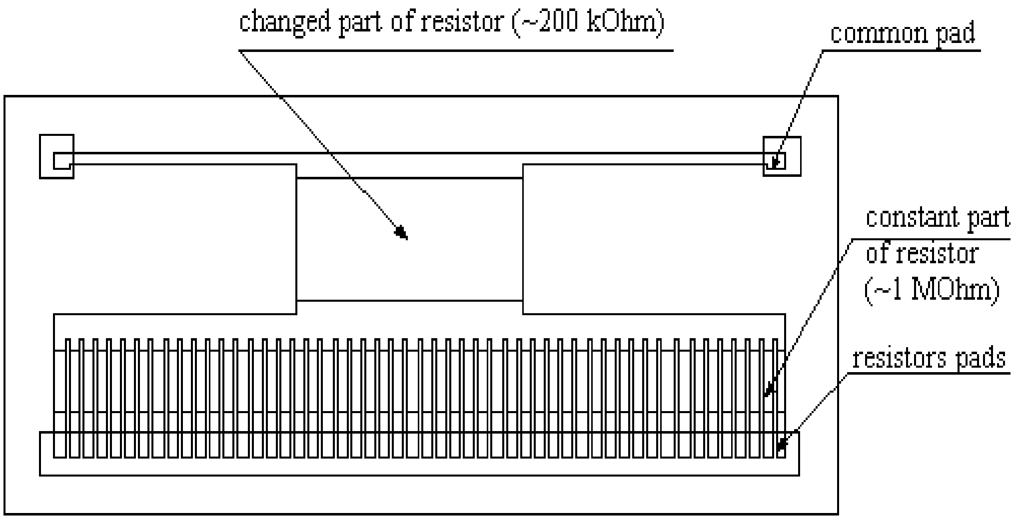

Figure 4: Bias resistors