

Modeling the thermal operation of CBM-STS stations

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For the estimation of the temperature behaviour of the STS stations, thermal demonstrators of silicon micro-strip detectors were developed and are under production in SE SRTIIE, with participation of the CBM-MPD STS Consortium. Four types of simulators were developed on the basis of mono-crystalline silicon. Their dimensions are the same as the sensors that are foreseen to be applied in the STS detector modules:

- type 1: 62 mm by 62 mm (with beam hole);
- type 2: 62 mm by 62 mm;
- type 3: 42 mm by 62 mm;
- type 4: 22 mm by 62 mm.

The thickness of the simulators also corresponds to the thickness of silicon sensors for the modules and amounts to 300 μm .

The technical solution chosen for the realization of the simulators utilizes a heating element placed on the oxidized silicon wafer (Fig. 1). The heating elements are made from adhesiveless nickel-polyimide foiled dielectric EFN-7-type (thickness of the nickel layer: 7 μm , polyimide layer: 10 μm). The application of this material and the design of the simulators simplify the assembly of the simulators into the station by soldering (nickel is more preferable for soldering than aluminium which is used e.g. for contact pads of diffusion resistors). For this purpose, the contact pads of the heating elements are tinned. The heating elements are realized in a “meander”-type structure. The technological process for the manufacturing of the heating elements was developed as well as procedures of thinning of silicon wafers and gluing of heating elements.

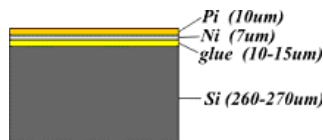


Figure 1: Structure of the thermal simulator

Several experimental samples of the thermal simulators were produced and investigated. A sample of type 4 is shown in Fig. 2. Fig. 3 shows results of a temperature cycle on the silicon wafer surface.

For the investigation of thermal operating modes of the stations, it is foreseen to manufacture sensor simulators arranged into a demonstrator of STS station 4 as shown in



Figure 2: A manufactured demonstrator of type 4

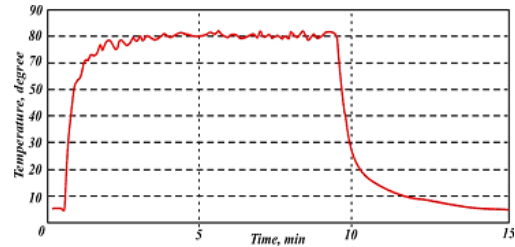


Figure 3: Temperature cycle on the silicon wafer

Fig. 4: 4 \times type 1, 86 \times type 2, 16 \times type 3 and 4 \times type 4.

The thermal simulators of sensors which were developed and are being produced will allow to perform investigations of the temperature operating modes of the CBM-STS stations and of the STS as a whole. The obtained results will be used in future for the construction of the Silicon Tracking System by the CBM-MPD STS Consortium.

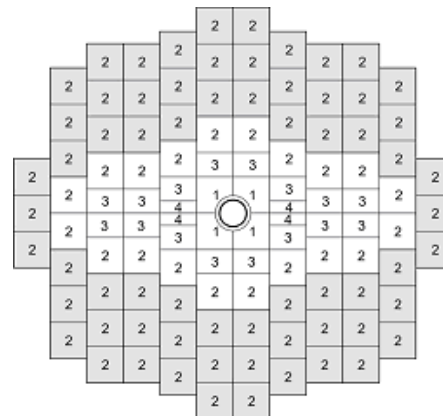


Figure 4: Arrangement of thermal simulators in configuration of STS Station 4 (right)