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MANUFACTURING METHOD OF A BISMUTH TELLURIDE-BASED THERMOELEMENT WITH COPPER SWITCHING

Modern advanced areas of practical use of thermoelectric converters demand that scientists develop a manufacturing method for a bismuth telluride-based thermoelement with copper switching, that would improve the performance parameters of thermoelectric modules.

Today, there are various technical solutions for thermoelement branches switching. Among the well-known technical solutions is [1] a method of thermoelements switching, which includes vacuum deposition of a high-temperature component of the *BiSb*-based switching layer on the thermoelements' branches. The study proposes the switching of thermocouples based on ternary alloys *BiTeSe* and *BiTeSb* in vacuum with tin-tinned copper conductors, including the operation of *BiSb* deposition and reactive brazing. However, such methods of thermoelement switching have disadvantages and cannot fully satisfy the quality requirements for joints of semiconductor material with a switching plate [2].

The current problem is solved by manufacturing of thermoelectric modules, in which liquid interlayers are used to weld the branches of the thermoelement. Such liquid interlayers allow to activate the contact surface, to equalize the welding pressure and to reduce the welding temperature. Gallium, which actively interacts with many metals with the formation of intermetallics, can be used as such a layer. The method of thermoelectric module branch manufacturing is carried out as follows.

The first step is to scrub the copper sample and degrease it with ethanol. Apply gallium to the cleaned and prepared copper surface by rubbing. Remove the excess gallium layer. Bismuth telluride also undergoes scraping and degreasing. Then we rub the bismuth telluride using a copper sample that has already been pre-coated with gallium. On the modified copper switching plate [3], the solder Rose's alloy is aplly using the soldering iron. Remove the excess solder layer. The finished samples of bismuth telluride and copper switching plate are assembled in a diffusion chamber and welded. Welding mode: welding temperature is $T_{welding} = 623\ K$, welding time is $t_{welding} = 3600\ sec$, welding pressure is $P = 30\ MPa$. The value of the welding pressure is quite high, but in this technical solution, strain limiters were used. The strain value was predetermined at 2-3 % (200-300 μm).

Such technical solution makes it possible to manufacture the branches of the thermoelement while preserving the operational parameters of the thermoelectric modules.

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