Citation List

Patent Literature

[0006]

Patent Literature 1: WO2014/163167

SUMMARY~~ OF INVENTION~~

PROBLEM TO BE SOLVED BY ~~INVENTION~~DISCLOSURE

[0007]

On the other hand, in the solder joint part, a phenomenon referred to as "spalling" has been observed in which the alloy layer is spalled from the interface by aging treatment. This phenomenon referred to as "spalling" means that when a proportionate heat treatment (temperature and time) is applied to the joint part, an originally formed IMC layer (Intermetallic Compound layer) is spalled into the solder bulk. When the solder alloy contains Ni therein as in Patent Document 1, "spalling" is more likely to be caused. The electric current is a flow of electrons, and thus, the increased amount of "spalling" of such an intermetallic compound locally blocks the transfer of electrons, thereby adversely affecting the acoustic quality (generating noises). Further, the inventors have confirmed that in the case where the alloy contains Ni, the particle size of the alloy is made finer. It is presumed that the

particle size of the intermetallic compound is made finer as described, thereby more easily causing “spalling”.

[0008]

The present ~~invention~~ disclosure provides a solder alloy and the like that can prevent adverse effects on the acoustic quality, by suppression or the like of spalling of compounds into the alloy in the case of remelting a joint or applying a high-temperature load, while achieving higher heat cycle characteristics than before.

SOLUTION TO SOLVE PROBLEM

[0009]

A solder alloy according to the present ~~invention~~ disclosure may comprise Ag: 3.1 to 4.0% by mass, Cu: 0.6 to 0.8% by mass, Bi: 1.5 to 5.5% by mass, Sb: 1.0 to 6.0% by mass, Co: 0.001 to 0.030% by mass, Fe: 0.02 to 0.05% by mass, and a balance Sn.

[0009a]

In one aspect, the present disclosure provides a solder alloy consisting of Ag: 3.1 to 4.0% by mass, Cu: 0.6 to 0.8% by mass, Bi: 1.5 to 5.5% by mass, Sb: 1.0 to 6.0% by mass, Co: 0.001 to 0.030% by mass, Fe: 0.02 to 0.05% by mass, and a balance Sn.

[0009b]

In another aspect, the present disclosure provides a

solder alloy consisting of Ag: 3.1 to 4.0% by mass, Cu: 0.6 to 0.8% by mass, Bi: 1.5 to 5.5% by mass, Sb: 1.0 to 6.0% by mass, Co: 0.001 to 0.030% by mass, Fe: 0.02 to 0.05% by mass, As: 0.002 to 0.250% by mass, and a balance Sn.

[0009c]

In another aspect, there is provided a solder paste having a solder powder being the solder alloy as defined above, and a flux.

[0009d]

In another aspect, there is provided a solder ball being the solder alloy as defined above.

[0009e]

In another aspect, there is provided a solder preform being the solder alloy as defined above.

[0009f]

In another aspect, there is provided a solder joint having the solder alloy as defined above.

[0009g]

In another aspect, there is provided an in-vehicle electronic circuit having the solder alloy as defined above.

[0009h]

In another aspect, there is provided an ECU electronic circuit having the solder alloy as defined above.

[0009i]

In another aspect, there is provided an in-vehicle electronic circuit device including the in-vehicle electronic circuit as defined above.

[0009j]

In another aspect, there is provided an ECU electronic circuit device including the ECU electronic circuit as defined above.

[0010]

The solder alloy according to the present ~~invention~~ disclosure may further comprise 0.002 to 0.250% by mass of As.

[0011]

In the solder alloy according to the present ~~invention~~disclosure,

a sum of a value of the % by mass of Fe and a value of three times the % by mass of Co is 0.03 to 0.10.

[0012]

The solder alloy according to the present ~~invention~~ disclosure may further comprise 0.004 to 0.250% by mass of Zr.

[0013]

According to the present disclosure~~invention~~, a solder paste having a solder powder being the solder alloy according to any one of the above solder alloys and a flux is provided.

[0014]

According to the present disclosure~~invention~~, a solder ball and a solder preform being the solder alloy according to any one of the above solder alloys are provided.

[0015]

According to the present disclosure~~invention~~, a solder joint, an in-vehicle electronic circuit and an ECU electronic circuit having any one of the above solder alloys are provided.

[0016]

According to the present disclosure~~invention~~, an in-vehicle electronic circuit device including the above in-vehicle electronic circuit is provided.

[0017]

According to the present disclosure~~invention~~, an ECU electronic circuit device including the ECU electronic circuit is provided.

[0018]

By adopting a solder alloy comprising Ag: 3.1 to 4.0%

by mass, Cu: 0.6 to 0.8% by mass, Bi: 1.5 to 5.5% by mass, Sb: 1.0 to 6.0% by mass, Co: 0.001 to 0.030% by mass, Fe: 0.02 to 0.05% by mass, and a balance Sn like the present disclosure~~invention~~, it is possible to provide a solder alloy and the like that can prevent adverse effects on the acoustic quality, by suppression or the like of spalling of compounds into the alloy in the case of remelting a joint or applying a high-temperature load, while achieving higher heat cycle characteristics. By adopting a solder alloy further comprising 0.004 to 0.250% by mass of As, it is possible to provide a solder alloy and the like that suppress the generation of voids and improve the acoustic quality.

BRIEF DESCRIPTION OF DRAWINGS

[0019]

Fig. 1 is an image that shows the result of a cross-section observation in Example 1.

Fig. 2 is an image that shows the result of a cross-section observation in Comparative Example 12.

Fig. 3 is an image that shows the result of an observation through a heating X-ray device in Example 14.

Fig. 4 is an image that shows the result of an observation through a heating X-ray device in Example 1.

Fig. 5 is a schematic diagram illustrating a method for

CLAIMS

1. A solder alloy ~~comprising~~ consisting of Ag: 3.1 to 4.0% by mass, Cu: 0.6 to 0.8% by mass, Bi: 1.5 to 5.5% by mass, Sb: 1.0 to 6.0% by mass, Co: 0.001 to 0.030% by mass, Fe: 0.02 to 0.05% by mass, and a balance Sn.

2. A~~The~~ solder alloy ~~according to claim 1 containing 0.002 to 0.250% by mass of As~~consisting of Ag: 3.1 to 4.0% by mass, Cu: 0.6 to 0.8% by mass, Bi: 1.5 to 5.5% by mass, Sb: 1.0 to 6.0% by mass, Co: 0.001 to 0.030% by mass, Fe: 0.02 to 0.05% by mass, As: 0.002 to 0.250% by mass, and a balance Sn.

3. The solder alloy according to claim 1 or 2, wherein a sum of a value of the % by mass of Fe and a value of three times the % by mass of Co is 0.03 to 0.10.

4. A solder paste having a solder powder being the solder alloy according to any one of claims 1 to 3, and a flux.

5. A solder ball being the solder alloy according to any one of claims 1 to 3.

6. A solder preform being the solder alloy according to

any one of claims 1 to 3.

7. A solder joint having the solder alloy according to any one of claims 1 to 3.

8. An in-vehicle electronic circuit having the solder alloy according to any one of claims 1 to 3.

9. An ECU electronic circuit having the solder alloy according to any one of claims 1 to 3.

10. An in-vehicle electronic circuit device including the in-vehicle electronic circuit according to claim 8.

11. An ECU electronic circuit device including the ECU electronic circuit according to claim 9.