## CLAIMS

[Claim 1] A method of manufacturing a barrier-metal-free metal interconnect structure, comprising:

filling ~~at least~~ a first interconnect trench with an intermetallic compound by depositing the intermetallic compound on an insulating layer having the first interconnect trench and a second interconnect trench formed in the insulating layer, the second interconnect trench being wider than the first interconnect trench;

depositing a second metal on the intermetallic compound to fill the second interconnect trench with the second metal after the first interconnect trench is filled with the intermetallic compound, the second metal being different from the intermetallic compound;

performing a planarization process of polishing the second metal and the intermetallic compound until the insulating layer is exposed; and then

performing a height adjustment process of polishing the second metal, the intermetallic compound and the insulating layer until a height of the intermetallic compound in the first interconnect trench reaches a predetermined height.

~~[Claim 2] The method according to claim 1, wherein the intermetallic compound is deposited on the insulating layer until the first interconnect trench and the second interconnect trench are filled with the intermetallic compound.~~

~~[Claim 3] The method according to claim 2, wherein the planarization process is performed using a first polishing liquid having a removal-rate selectivity that achieves a higher removal rate of the intermetallic compound than a removal rate of the insulating layer, and~~

~~the heigh adjustment process is performed using a second polishing liquid having a removal-rate selectivity that achieves a removal rate of the intermetallic compound which is the same as or lower than a removal rate of the insulating layer.~~

~~[Claim 4] The method according to claim 1, further comprising depositing a second metal on the intermetallic compound to fill the second interconnect trench with the second metal after the first interconnect trench is filled with the intermetallic compound, the second metal being different from the intermetallic compound.~~

~~[Claim 5] The method according to claim 4, wherein the planarization process is a process of polishing the second metal and the intermetallic compound until the insulating layer is exposed, and~~

~~the height adjustment process is a process of polishing the second metal, the intermetallic compound, and the insulating layer until the height of the intermetallic compound in the first interconnect trench reaches the predetermined height.~~

[Claim 2 ~~6~~] The method according to claim 1 ~~5~~, wherein the planarization process is performed using a first polishing liquid having a removal-rate selectivity that achieves higher removal rates of the second metal and the intermetallic compound than a removal rate of the insulating layer, and

the height adjustment process is performed using a second polishing liquid having a removal-rate selectivity that achieves removal rates of the second metal and the intermetallic compound which are the same as or lower than a removal rate of the insulating layer.

[Claim 3 ~~7~~] The method according to claim 1 ~~4~~, wherein the planarization process includes:

a first planarization process of polishing the second metal until the intermetallic compound is exposed; and

a second planarization process of polishing the second metal and the intermetallic compound until the insulating layer is exposed.

[Claim 4 ~~8~~] The method according to claim 3 ~~7~~, wherein the first planarization process is

performed using a first polishing liquid having a removal-rate selectivity that achieves a higher removal rate of the second metal than a removal rate of the intermetallic compound,

the second planarization process is performed using a second polishing liquid having a removal-rate selectivity that achieves higher removal rates of the second metal and the intermetallic compound than a removal rate of the insulating layer, and

the height adjustment process is performed using a third polishing liquid having a removal-rate selectivity that achieves removal rates of the second metal and the intermetallic compound which are the same as or lower than a removal rate of the insulating layer.

[Claim 5 ~~9~~] ~~The method according to claim 1, further comprising:~~ A method of manufacturing a barrier-metal-free metal interconnect structure, comprising:

filling a first interconnect trench with an intermetallic compound by depositing the intermetallic compound on an insulating layer having the first interconnect trench and a second interconnect trench formed in the insulating layer, the second interconnect trench being wider than the first interconnect trench;

forming a seed layer on the intermetallic compound after the first interconnect trench is filled with the intermetallic compound; and

depositing a second metal on the seed layer to fill the second interconnect trench with the second metal, the second metal being different from the intermetallic compound;

performing a planarization process of polishing the second metal, the seed layer, and the intermetallic compound until the insulating layer is exposed; and then

performing a height adjustment process of polishing the second metal, the seed layer, the intermetallic compound, and the insulating layer until a height of the intermetallic compound in the first interconnect trench reaches a predetermined height.

~~[Claim 10] The method according to claim 9, wherein the planarization process is a process of polishing the second metal, the seed layer, and the intermetallic compound until the~~

~~insulating layer is exposed, and~~

~~the height adjustment process is a process of polishing the second metal, the seed layer, the intermetallic compound, and the insulating layer until the height of the intermetallic compound in the first interconnect trench reaches the predetermined height.~~

[Claim 6 ~~11~~] The method according to claim 5, wherein the planarization process is performed using a first polishing liquid having a removal-rate selectivity that achieves higher removal rates of the second metal, the seed layer, and the intermetallic compound than a removal rate of the insulating layer, and

the height adjustment process is performed using a second polishing liquid having a removal-rate selectivity that achieves removal rates of the second metal, the seed layer, and the intermetallic compound which are the same as or lower than a removal rate of the insulating layer.

[Claim 7 ~~12~~] The method according to claim 5 ~~9~~, wherein the planarization process includes:

a first planarization process of polishing the second metal and the seed layer until the intermetallic compound is exposed; and

a second planarization process of polishing the second metal, the seed layer, and the intermetallic compound until the insulating layer is exposed.

[Claim 8 ~~13~~] The method according to claim 7 ~~12~~, wherein the first planarization process is performed using a first polishing liquid having a removal-rate selectivity that achieves higher removal rates of the second metal and the seed layer than a removal rate of the intermetallic compound,

the second planarization process is performed using a second polishing liquid having a removal-rate selectivity that achieves higher removal rates of the second metal, the seed layer, and the intermetallic compound than a removal rate of the insulating layer,

and

the height adjustment process is performed using a third polishing liquid having a removal-rate selectivity that achieves removal rates of the second metal, the seed layer, and the intermetallic compound which are the same as or lower than a removal rate of the insulating layer.

[Claim 9 ~~14~~] The method according to any one of claims 1 to 8 ~~13~~, wherein the intermetallic compound is $CuAl_2$ or NiAl.

[Claim 10 ~~15~~] A barrier-metal-free metal interconnect structure comprising:

an insulating layer having a first interconnect trench and a second interconnect trench formed therein, the second interconnect trench being wider than the first interconnect trench; ~~and~~

an intermetallic compound filling the first interconnect trench; and

an intermetallic compound and a second metal filling the second interconnect trench.

~~[Claim 16] The barrier-metal-free metal interconnect structure according to claim 15, further comprising an intermetallic compound filling the second interconnect trench.~~

~~[Claim 17] The barrier-metal-free metal interconnect structure according to claim 15, further comprising an intermetallic compound and a second metal filling the second interconnect trench.~~

[Claim 11 ~~18~~] The barrier-metal-free metal interconnect structure according to claim 10 ~~17~~, wherein the second metal is copper, titanium, or titanium nitride.

[Claim 12 ~~19~~] The barrier-metal-free metal interconnect structure according to claim 10 or 11 ~~any one of claims 15 to 18~~, wherein the first interconnect trench has a width smaller than

7 nm.

[Claim 13 ~~20~~] The barrier-metal-free metal interconnect structure according to any one of claims 10 ~~15~~ to 12 ~~19~~, wherein the intermetallic compound filling the first interconnect trench is $CuAl_2$ or NiAl.