Claims

1. A process for forming a permanent, electrically conductive connection between a first surface comprising metallic and non-metallic regions of a first substrate and a second surface comprising metallic and non-metallic regions of a second substrate, the process comprising:

conditioning the first and/or second surfaces;

aligning the first and second surfaces; and

forming the permanent, electrically conductive connection between the first and second surfaces, the forming comprising respectively contacting the metallic regions and the non-metallic regions of the first surface with the metallic regions and the non-metallic regions of the second surface to initiate substitution diffusion between metal ions and/or metal atoms of the metallic regions of the surfaces;

wherein, during the conditioning, the aligning, and the forming, a process temperature is equal to or less than 300°C.

2. The process according to claim 1, wherein the conditioning comprises implanting hydrogen in the first and second surfaces.

3. The process according to claim 1, wherein the conditioning comprises a producing surface defects in layers of the metallic regions near the surfaces, the producing comprising implanting gas ions in the near surface layers and/or applying metallic nanoparticles to the near surface layers.

4. The process according to one of the preceding claims, wherein the non-metallic regions comprise silicon dioxide or an organic insulator.

5. The process according to claim 3, wherein the gas ions are hydrogen ions.

6. The process according to one of the preceding claims, wherein the conditioning comprises optimizing a surface roughness of at least one of the surfaces.

7. A process for forming a permanent, electrically conductive connection between a first metal surface of a first substrate and a second metal surface of a second substrate, the process comprising:

conditioning of the first and second metal surfaces, the conditioning comprising producing surface defects in respective layers near the first and second metal surfaces to promote substitution diffusion between the metal surfaces;

aligning the first and second metal surfaces; and

forming the permanent, electrically conductive connection between the first and second metal surfaces, the forming comprising:

connecting the first and second metal surfaces to initiate substitution diffusion between metallic ions and/or metal atoms of the two metal surfaces; and

applying a temperature treatment after the connecting to eliminate the surface defects in the near surface layers.

8. The process according to claim 7, wherein the applying comprises plastically deforming the second metal surface and eliminating empty areas between the metal surfaces connected to each other.

9. The process according to claim 7, wherein the producing comprises implanting gas ions in the near surface layers and/or applying metallic nanoparticles to the near surface layers.

10. The process according to claim 7, wherein the producing comprises implanting hydrogen in metal surfaces.

11. The process according to claim 7, wherein the conditioning further comprises optimizing a surface roughness of at least one of the metal surfaces.

12. A process for forming a permanent, electrically conductive diffusion bond connection between a first metal surface of a first substrate and a second metal surface of a second substrate, the process comprising:

conditioning the first and second metal surfaces for diffusion therebetween;

aligning the first and second metal surfaces; and

forming the permanent, electrically conductive diffusion bond, the forming comprising initiating diffusion between the first metal surface and the second metal surface, the initiating comprising:

contacting the first metal surface with the second metal surface; and

applying a temperature treatment after the contacting to plastically deform the second metal surface and eliminate empty areas between the metal surfaces in contact with each other.

13. The process according to claim 12, wherein the conditioning comprises implanting hydrogen in the first and second metal surfaces.

14. A process for forming a permanent, electrically conductive connection between a first metal surface of a first substrate and a second metal surface of a second substrate, the process comprising:

conditioning the first and second metal surfaces;

aligning the first and second metal surfaces; and

forming the permanent, electrically conductive connection between the first and second metal surfaces, the forming comprising connecting the first and second metal surfaces to initiate grain boundary diffusion of metallic ions between similar metal ions and/or metal atoms of the first and second metal surfaces,

wherein, during the conditioning, the aligning and the forming, a process temperature is equal to or less than 300°C.