CLAIMS

What is claimed is:

1. A method for manufacturing a graphene-metal composite comprising: depositing graphene onto a porous metal foam substrate; growing carbon nanotube ropes throughout the porous metal foam substrate using a catalyst material and a heated carbon-rich gas flowing over the porous metal foam substrate, wherein the carbon nanotube ropes occupy voids within the porous metal foam substrate; and compressing the porous metal foam substrate with graphene applied to form a graphene-metal composite, when compressed the carbon nanotube ropes leaving a thermal and electrical pathway through the porous metal foam substrate.

2. The method according to claim 1, wherein the porous metal foam substrate is nickel or copper foam.

3. The method according to claim 1, wherein the porosity of the porous metal foam substrate is at least 70%.

4. The method according to claim 1, wherein the depositing graphene to a porous metal foam substrate is by chemical vapor deposition.

5. The method according to claim 1, wherein the depositing graphene to a porous metal foam substrate is by growing carbon nanotubes on the surface of the porous metal foam substrate before compressing the porous metal foam substrate.

6. The method according to claim 1, wherein the depositing graphene to a porous metal foam substrate comprises 3D printing thermal elastomers or metal into voids in the porous metal foam substrate surface before compressing the porous metal foam substrate.

7. The method according to claim 6, wherein the thermal elastomers or metal are selectively added to certain areas of the porous metal foam substrate before compressing the porous metal foam substrate.

8. The method according to claim 1, wherein the porous metal foam substrate with graphene applied is compressed to substantially close the voids in the porous metal foam substrate and make the compressed porous metal foam substrate with graphene applied thinner than the thickness of the non-compressed porous metal foam substrate.

9. The method according to claim 1, further comprising die casting or injection molding the graphene-metal composite into an aluminum, zinc, or plastic frame.

10. The method according to claim 1, further comprising roll bonding the graphene-metal composite into a structural member.

11. The method according to claim 1, further comprising roll bonding at least one layer of graphene-metal composite to at least one layer of copper foil coated with graphene.

12. A method for manufacturing a graphene-metal composite comprising: depositing a layer of graphene onto a porous metal foam substrate; applying a layer of metal on top of the layer of graphene; depositing another layer of graphene onto the layer of metal; growing carbon nanotube ropes throughout the porous metal foam substrate using a catalyst material and a heated carbon-rich gas flowing over the porous metal foam substrate, wherein the carbon nanotube ropes occupy voids within the porous metal foam substrate; and compressing the multilayered porous metal foam substrate to form a graphene-metal composite, when compressed the carbon nanotube ropes leaving a thermal and electrical pathway through the porous metal foam substrate.

13. The method according to claim 12, wherein the applying a layer of metal on top of the layer of graphene and depositing another layer of graphene onto the layer of metal is repeated until a desired number of layers are made before compressing the multi-layered porous metal foam substrate.

14. The method according to claim 12, wherein the layer of metal is applied to the layer of graphene by flash coating.

15. The method according to claim 12, wherein the metal applied to the layer of graphene is either nickel or copper.

16. The method according to claim 12, wherein the metal applied to the layer of graphene is palladium.

17. The method according to claim 12, wherein the metal applied to the layer of graphene is gold.

18. The method according to claim 12, wherein the porous metal foam substrate is nickel or copper foam.

19. The method according to claim 12, wherein the porosity of the porous metal foam substrate is at least 70%.

20. The method according to claim 12, wherein depositing graphene layers is by chemical vapor deposition.