CLAIMS

What is claimed is:

1. A method of fabricating a three-dimensional graphene crystalline foam, comprising:

a) mixing a carbon source and a skelet powder together to obtain a uniform mixture, wherein the carbon source is optionally coated on a group IV-B element;

b) applying pressure to the uniform mixture obtained in step (a) to obtain a closed packed structure;

c) applying temperature and pressure to the closed packed structure to form a graphene sheet layered around the skelet powder and the group IV-B element if present; and

d) removing the skelet powder from the closed packed structure using a chemical bath to dissolve the skelet powder away from the closed packed structure leaving voids, resulting in a three-dimensional crystalline foam comprising graphene and optionally a group IV-B element.

2. The method of ~~Claim~~ claim 1, wherein the carbon source is carbon black, amorphous carbon, or a combination thereof.

3. The method of ~~Claim~~ claim 1, wherein the optional group IV-B element is silicon (Si), germanium (Ge), tin (Sn), lead (Pb), or a combination thereof.

4. The method of ~~Claim~~ claim 1, wherein the carbon-coated group IV-B element is carbon-coated silicon nanoparticle.

5. The method of ~~Claim~~ claim 1, wherein the skelet powder is silicon dioxide (SiO_2), aluminum oxide (Al_2O_3), sodium chloride (NaCl), magnesium oxide (MgO), hafnium oxide (HfO_2), zirconium dioxide (ZrO_2), or a combination thereof.

6. The method of ~~Claim~~ claim 1, wherein the skelet powder has a particle size of between about 1 nm to 10 μm.

7. The method of ~~Claim~~ claim 1, wherein the pressure is applied in a uniform direction.

8. The method of ~~Claim~~ claim 1, wherein the chemical bath is aqueous potassium hydroxide or aqueous sodium hydroxide.

9. A method of fabricating a three-dimensional crystalline graphene foam, comprising:

a) providing a three-dimensional metal foam framework having a surface area of at least about 500 m^2/g, for fabricating a three-dimensional graphene foam;

b) depositing a layer of graphene onto the metal foam of step (a) by template-directed chemical vapor deposition (CVD);

c) depositing a polymer support onto the graphene layer;

d) removing the three-dimensional metal foam framework via wet chemical etching, such that the graphene layer and the polymer support retain the three-dimensional configuration provided by the metal foam framework; and

e) removing the polymer support using a solvent to thereby obtain the three-dimensional crystalline graphene foam~~.~~ wherein the metal foam framework of step (a) is fabricated by:

i) mixing a metal powder and a skelet powder together to obtain a uniform mixture;

ii) applying pressure to the uniform mixture of the metal powder and the skelet powder to obtain a closed packed structure;

iii) applying temperature and pressure to the closed packed structure obtained in step (ii) to melt the metal powder around the skelet powder; and

iv) removing the skelet powder using a chemical bath to dissolve the skelet powder away from the closed packed structure leaving voids, resulting in a metal foam.

~~10. The method of Claim 9, wherein the metal foam framework of step (a) is fabricated by a method, comprising:~~

~~i) mixing a metal powder and a skelet powder together to obtain a uniform mixture;~~

~~ii) applying pressure to the mixture of the metal powder and the skelet powder to obtain a closed packed structure;~~

~~iii) applying temperature and pressure to the mixture obtain in step (b) to melt the metal powder around the skelet powder; and~~

~~iv) removing the skelet powder using a chemical bath to dissolve the skelet powder away from the structure leaving voids, resulting in a metal foam.~~

~~11.~~10. The method of ~~Claim 10~~ claim 9, wherein the metal powder is composed of nickel (Ni), cobalt (Co), copper (Cu), iron (Fe), platinum (Pt), or a combination thereof.

~~12.~~11. The method of ~~Claim 10~~ claim 9, wherein the skelet powder is silicon dioxide (SiO_2), aluminum oxide (Al_2O_3), sodium chloride (NaCl), magnesium oxide (MgO), hafnium oxide (HfO_2), zirconium dioxide (ZrO_2), or a combination thereof.

~~13.~~12. The method of ~~Claim 10~~ claim 9, wherein the skelet powder has a particle size of between about 1 nm to 10 μm.

~~14.~~13. The method of ~~Claim 10~~ claim 9, wherein the pressure is applied in a uniform direction.

~~15. A three-dimensional crystalline graphene foam, comprising:~~

~~a core comprising a group IV-B element; and~~

~~a layer surrounding the core comprising graphene to form a three-dimensional crystalline foam comprising graphene and a group IV-B element.~~

~~16. The three-dimensional crystalline graphene foam of Claim 15, wherein the group IV-B element is silicon (Si), germanium (Ge), tin (Sn), lead (Pb), or a combination thereof.~~

~~17. A three-dimensional framework for producing three-dimensional crystalline foam having electrical conductive properties, comprising a metal foam having a surface area of at least 500 m^2/g.~~