CLAIMS

What is claimed is:

1. A system for powder composite fabrication, comprising a powder material, a photocurable material, and a powder composite fabrication machine, the powder composite fabrication machine comprising:

a build platform;

a powder transfer device configured to deliver a first layer powder material to the build platform;

a resin supply system in communication with the build platform and configured to deliver the photocurable material through the build platform for infusion into the first layer of the powder material; and

an imaging device positioned above the build platform and configured to selectively irradiate the photocurable material to form a first layer of a powder composite component;

wherein the powder transfer device is configured to deliver a second layer of the powder material on the first layer of the powder material, the resin supply system is configured to deliver the photocurable material, through the build platform and the first layer of the powder material infused with the photocurable material, for infusion into the second layer of the powder material, and the imaging device is configured to selectively irradiate the photocurable material in the second layer of the powder material to form a second layer of the powder composite component.

2. The system of claim 1, wherein the build platform is selectively movable with respect to the imaging device to accommodate the formation of multiple layers of the powder composite component.

3. The system of claim 1, wherein the powder transfer device comprises a roller that is movable to transfer the powder material from a powder supply chamber to the build platform.

4. The system of claim 1, wherein the powder transfer device is configured to deliver powder material from multiple powder sources.

5. The system of claim 1, comprising a compression device configured to control a density of the powder material delivered to the build platform.

6. A method for powder composite fabrication, the method comprising:

delivering a first layer of a powder material to a build platform;

delivering a photocurable material through the build platform;

infusing the first layer of the powder material with the photocurable material;

selectively activating an imaging device to irradiate the photocurable material to form a first layer of a powder composite component;

delivering a second layer of the powder material on the first layer of the powder material;

delivering the photocurable material through the build platform and the first layer of the powder

material infused with the photocurable material;

infusing the second layer of the powder material with the photocurable material; and selectively irradiating the photocurable material in the second layer of the powder material to form a second layer of the powder composite component.

7. The method of claim 6, wherein delivering the powder material to the build platform comprises:

expelling a metered quantity of powder material from a powder supply chamber; and

transferring the metered quantity of powder material to the build platform.

8. The method of claim 6, wherein delivering the powder material to the build platform comprises controlling a density of the powder material.

9. The method of claim 8, wherein controlling a density of the powder material comprises increasing a volumetric powder loading density of the powder material to be greater than a free density after deposition.

10. The method of claim 6, wherein delivering the powder material to the build platform comprises delivering different powder materials from multiple powder sources to the build platform.

11. The method of claim 10, wherein delivering different powder materials from multiple powder sources comprises delivering a build powder and a support powder to the build platform.

12. The method of claim 6, wherein selectively activating the imaging device comprises irradiating the photocurable material over a selected fraction of a respective cross-section of the power composite component to at least partially solidify a layer of the powder composite component to have a porosity sufficient to allow the photocurable material to flow through the layer during repeated steps of delivering the photocurable material; and

wherein repeating the steps of delivering the powder material, delivering a photocurable material, infusing the powder material with photocurable material, and selectively irradiating the photocurable material comprises repeatedly:

delivering powder material on top of one or more previously irradiated layers of the powder composite component;

delivering the photocurable material through the one or more previously irradiated layers of the powder composite component to infuse the powder material; and

selectively activating the imaging device to irradiate the photocurable material to at least partially solidify a next layer of the powder composite component.

13. The method of claim 6, wherein selectively activating the imaging device comprises irradiating only a perimeter of a respective cross-section of the power composite component to form a skin around the powder material and photocurable material; and

wherein, upon completion of the skin, the method comprises:

removing the photocurable material from the powder material;

infusing the powder material with a binding medium;

removing the skin to reveal a green part comprised of the powder material and the binding medium.

14. The method of claim 6, comprising lowering the build platform an increment away from the imaging device prior to repeating the steps of delivering a powder material, delivering a photocurable material, infusing the powder material, and selectively irradiating the powder material, wherein each layer of the powder composite component is formed on top of a preceding layer.

15. The method of claim 6, comprising performing post-processing to partially or completely remove the photocurable material from the powder composite component.