~~**What is claimed is:**~~

CLAIMS

1. A physical vapor deposition (PVD) system, comprising:

a vacuum processing chamber comprising:

a sputtering target;

a substrate support disposed within the vacuum processing chamber configured

to position a substrate proximate to the sputtering target;

a deposition shield disposed within the vacuum processing chamber;

a processing region disposed within the vacuum processing chamber and bounded by a surface of the target, a surface of the substrate support, and an inner surface of the deposition shield; ~~and~~

a coil portion of an electromagnet, wherein the coil portion is disposed within the

vacuum processing chamber and outside the processing region~~.~~;

~~2. The PVD system of claim 1, further comprising~~ an annular structure on which the coil portion is disposed, wherein the annular structure is disposed within the vacuum processing chamber and outside of the processing region~~.~~, wherein the coil portion and a cooling channel are disposed in a cavity formed in the annular structure, and wherein the cooling channel is sealed from the coiled portion; and

a cover plate that fluidly separates the coil portion from a vacuum containing portion of the vacuum processing chamber.

2.

~~3.~~ The PVD system of claim ~~2~~1, wherein the ~~annular structure includes a conduit~~cooling channel is configured for flowing of a cooling liquid within the annular structure.

3. The PVD system of claim 2, wherein the annular structure is coupled to a body of the vacuum processing chamber via multiple pylons, and the cooling channel is fluidly coupled to a supply conduit formed within at least one of the multiple pylons and to a return conduit formed within at least one of the multiple pylons.

4. The PVD system of claim ~~3~~2, wherein the ~~conduit~~cooling channel includes multiple channels that are fluidly separated from each other by a divider.

5. The PVD system of claim 4, wherein the divider is configured to support a water cover that fluidly separates the coil from the conduit.

6. The PVD system of claim 2, wherein the ~~coil is disposed in a cavity formed in~~portion of the annular structure that includes the conduit is formed via a 3D printing process.

7. The PVD system of claim ~~6, further comprising a cover plate that fluidly separates the coil from vacuum when vacuum is present in the vacuum processing chamber.~~

~~8. The PVD system of claim 6~~1, wherein the cavity is fluidly coupled to atmosphere exteriorly of the vacuum processing chamber during processing of substrates within the vacuum processing chamber.

~~9~~8. The PVD system of claim 1, wherein the annular structure is coupled to a body of the vacuum processing chamber via multiple pylons.

9. The PVD system of claim 1, wherein the deposition shield is coupled to the coil portion.

10. The PVD system of claim 9, wherein the deposition shield is coupled to an outer surface of the coil portion.

11. The PVD system of claim 1, further comprising a direct current (DC) power supply coupled to the coil portion.

~~10~~12. The PVD system of claim ~~9~~11, wherein the DC power supply comprises one of a programmable power supply configured to generate a variable DC output in response to a command selecting an output profile or a controllable power supply configured to generate a variable DC output in response to an input value.

~~11~~13. The PVD system of claim 1, further comprising an additional coil portion of an additional electromagnet, wherein the additional coil portion is disposed within the vacuum processing chamber and outside the processing region.

~~12~~14. The PVD system of claim ~~11~~13, wherein the coil portion is coupled to a first DC power supply and the additional coil portion us coupled to a second DC power supply.

~~13~~15. A method of physical vapor deposition in a vacuum chamber, the method comprising:

positioning a substrate in a processing region of the vacuum chamber, wherein the processing region is disposed between a surface of a sputtering target of the vacuum chamber, a surface of a substrate support in the vacuum chamber, and an inner surface of a deposition shield disposed in the vacuum chamber;

generating a plasma in a processing region; and

~~—~~when the plasma is present in the processing region, applying direct current (DC) power to a coil portion of an electromagnet, wherein the coil portion is disposed within the vacuum chamber and outside the processing region, wherein the coil

portion and a cooling channel are disposed in a cavity formed in an annular structure disposed in the vacuum chamber and outside the processing region, wherein the cooling channel is sealed from the coiled portion, and wherein a cover plate fluidly separates the coil portion from a vacuum containing portion in the vacuum chamber.

~~14~~16. The method of claim ~~13, wherein the coil portion is disposed on an annular structure, the method~~15, further comprising, when the plasma is present in the processing region, supplying a cooling liquid to ~~a conduit~~the cooling channel disposed within the annular structure.

~~15~~17. The method of claim ~~13~~15, wherein applying the DC power to the coil portion comprises applying pulsed DC power to the coil portion from a variable output DC power source.