CLAIMS

1. A turbine blade assembly, comprising:

a disk; and

a plurality of turbine blades coupled to the disk,

wherein each of the turbine blades is composed of a metal and comprises:

a blade portion; and

a root coupled to the blade portion and comprising a protective coating disposed on the metal of the root, wherein the protective coating comprises:

a deposited crystalline film comprising at least one of a metal oxide, a metal nitride, or a metal oxynitride, and

a thickness of about 100 nm to about 10 μm.

2. The turbine blade assembly of claim 1, wherein the disk comprises a plurality of receiving surfaces, and wherein each of the turbine blades is coupled to a respective receiving surface of the plurality of receiving surfaces.

3. The turbine blade assembly of claim 2, wherein each of the receiving surfaces comprises a disk protective coating disposed thereon.

4. The turbine blade assembly of claim 3, wherein the disk protective coating comprises:

a second deposited crystalline film comprising at least one of a metal oxide, a metal nitride, or a metal oxynitride, and

a thickness of about 100 nm to about 10 μm.

5. The turbine blade assembly of claim 4, wherein the plurality of the turbine blades comprises about 50 blades to about 200 blades.

6. The turbine blade assembly of claim 3, wherein each of the protective coating and the disk protective coating independently has a thickness of about 200 nm to about 5 μm.

7. The turbine blade assembly of claim 1, wherein the protective coating has a thickness of about 500 nm to about 2 μm.

8. The turbine blade assembly of claim 1, wherein the protective coating comprises one or more crystalline materials selected from aluminum oxide, aluminum silicate, aluminum nitride, aluminum oxynitride, chromium oxide, chromium silicate, silicon oxide, silicon nitride, silicon carbide, yttrium oxide, yttrium silicate, yttrium nitride, yttrium silicon nitride, hafnium oxide, hafnium nitride, hafnium silicide, hafnium silicate, titanium oxide, titanium silicide, titanium silicate, dopants thereof, alloys thereof, or any combination thereof.

9. The turbine blade assembly of claim 1, wherein the protective coating comprises one or more crystalline materials selected from aluminum oxide, chromium oxide, hafnium oxide, yttrium oxide, dopants thereof, alloys thereof, or any combination thereof.

10. The turbine blade assembly of claim 1, wherein the deposited crystalline film is deposited by an atomic layer deposition (ALD) process, a plasma-enhanced ALD (PE-ALD) process, a thermal chemical vapor deposition (CVD) process, a plasma-enhanced CVD (PE-CVD) process, a pulsed-CVD process, a physical vapor deposition (PVD) process, or any combination thereof.

11. The turbine blade assembly of claim 1, wherein the deposited crystalline film is annealed by a thermal anneal, a plasma anneal, a light anneal, or any combination thereof.

12. The turbine blade assembly of claim 11, wherein the deposited crystalline film is annealed by rapid thermal processing (RTP), a laser anneal, an ultraviolet anneal, an infrared anneal, a visible light anneal, or any combination thereof.

13. The turbine blade assembly of claim 1, wherein each of the protective coating and the deposited crystalline film independently has a thickness variation of less than 20%.

14. The turbine blade assembly of claim 1, wherein each of the protective coating and the deposited crystalline film independently has a thickness variation of less than 10%.

15. The turbine blade assembly of claim 1, wherein each of the protective coating and the deposited crystalline film independently has a thickness variation of less than 5%.

16. A turbine blade assembly, comprising:

a disk; and

a plurality of turbine blades coupled to the disk,

wherein each of the turbine blades is composed of a metal and comprises:

a blade portion; and

a root coupled to the blade portion and comprising a protective coating disposed on the metal of the root, wherein the protective coating comprises:

a deposited crystalline film comprising at least one of a metal oxide, a metal nitride, or a metal oxynitride, and

a thickness of about 100 nm to about 10 μm,

wherein the disk comprises a plurality of receiving surfaces,

wherein each of the turbine blades is coupled to a respective receiving surface of the plurality of receiving surfaces,

wherein each of the receiving surfaces comprises a disk protective coating disposed thereon, and

wherein each of the protective coating and the disk protective coating independently has a thickness of about 200 nm to about 5 μm.

17. The turbine blade assembly of claim 16, wherein the disk protective coating comprises:

a second deposited crystalline film comprising at least one of a metal oxide, a metal nitride, or a metal oxynitride, and

a thickness of about 100 nm to about 10 μm.

18. The turbine blade assembly of claim 16, wherein each of the protective coating and the disk protective coating independently has a thickness of about 500 nm to about 2 μm.

19. The turbine blade assembly of claim 16, wherein each of the protective coating and the disk protective coating independently comprises one or more crystalline materials selected from aluminum oxide, chromium oxide, hafnium oxide, yttrium oxide, dopants thereof, alloys thereof, or any combination thereof.

20. A turbine blade composed of a metal, comprising:

a blade portion; and

a root coupled to the blade portion and comprising a protective coating disposed on the metal of the root, wherein the protective coating comprises:

a deposited crystalline film comprising at least one of a metal oxide, a metal nitride, or a metal oxynitride, and

a thickness of about 100 nm to about 10 μm.

21. The turbine blade assembly of claim 1, wherein the metal comprises nickel, chromium, cobalt, chromium-cobalt alloys, molybdenum, iron, titanium, a nickel superalloy, alloys thereof, or any combination thereof.

22. The turbine blade assembly of claim 16, wherein the metal comprises nickel, chromium, cobalt, chromium-cobalt alloys, molybdenum, iron, titanium, a nickel superalloy, alloys thereof, or any combination thereof.

23. The turbine blade of claim 20, wherein the metal comprises nickel, chromium, cobalt, chromium-cobalt alloys, molybdenum, iron, titanium, a nickel superalloy, alloys thereof, or any combination thereof.