Grooves are formed along portions of the side edges of a turbine bucket platform and open through the side edges of the surface of the platform exposed to the hot gas path of the turbine. A bond coat is applied to the groove followed by a thermal barrier coating which is preferably plasma sprayed onto the bond coat. The thermal barrier coating thickness protects the coating beyond the surface of the bare metal of the platform side and is then abraded or ground to lie flush with the bare metal surface. Thus, the side faces of the platform have a thermal barrier coating to reduce oxidation.
THERMAL BARRIER COATING FOR TURBINE
BUCKET PLATFORM SIDE FACES AND
METHODS OF APPLICATION

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a thermal barrier coating applied to side faces of the platform of a turbine bucket and methods of application.

[0002] Over the years, gas turbines have trended towards increased inlet firing temperatures to improve output and engine efficiencies. As gas path temperatures have increased, bucket platforms have increasingly exhibited stress including oxidation, creep and low cycle fatigue cracking. In certain turbines using closed circuit steam cooling in the first two stages of buckets and nozzles, inlet profiles have become such that the platforms are staying close to peak inlet temperatures for the blade row. This exacerbates the potential distress on bucket platforms as the platforms run even hotter.

[0003] In many older turbine designs, the bucket platforms did not require a coating to prevent oxidation distress due to firing temperatures. The firing temperatures were not sufficiently high to cause substantial distress. Also, film cooling carryover from upstream nozzle side walls tended to lower the temperatures near the platforms from the resulting pitch line bias of the inlet temperature profile. With the trend toward increasing firing temperatures, however, platform surfaces exposed to the hot gas path have been provided with a thermal barrier coating. However, there has also been discovered a need for minimizing the distress of the side faces of the platform which lie in generally circumferential registration with side faces of adjoining bucket platforms.

DETAILED DESCRIPTION OF THE INVENTION

[0004] In a preferred embodiment of the present invention there is provided a bucket for a turbine comprising: an airfoil, a root and a platform intermediate the airfoil and the root, the platform having generally circumferentially facing side faces for registration with generally corresponding side faces of adjacent buckets; each of the platform side faces having a groove therein opening circumferentially outwardly through the side faces; and a thermal barrier coating in the grooves and exposed along the side faces of the platform.

[0005] In a further preferred embodiment of the present invention, there is provided a method of protecting side faces of a platform of a turbine bucket comprising the steps of: forming a groove along a side face of the platform opening circumferentially outwardly through the side faces; applying a bond coat to the groove; applying a thermal barrier coating to the bond coating; and removing a portion of the thermal bond coating along the side face to render side face portions having the applied thermal barrier coating thereon and bare metal to lie flush with one another.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a perspective view of a turbine bucket illustrating a thermal barrier coating applied to the bucket platform surface and side faces of the platform;

[0007] FIG. 2 is a fragmentary cross-sectional view thereof, taken generally about line 2-2 in FIG. 1 illustrating the application of a bond coat and thermal barrier coating to the bucket; and

[0008] FIG. 3 is a view similar to FIG. 2 illustrating the finished bucket with applied thermal barrier coating.

[0009] Referring now to the drawing figures, particularly to FIG. 1, there is illustrated a turbine bucket generally designated 10 having an airfoil 12, a platform 14 and a root portion 16 including a shank 18 and dovetail 20. It will be appreciated that the turbine bucket 10 is typically arranged in an annular array of like turbine buckets on the rotor wheel of a turbine with the side faces 22 of the platform 14 generally circumferentially registering with corresponding side faces of circumferentially adjacent bucket platforms. Typically, the bucket surfaces are formed of bare metal.

[0010] While platform surfaces such as the platform surface 24 illustrated in FIG. 1 have previously received a thermal barrier coating, the side faces 22 of the platform which lie in circumferential registration with side faces of adjacent bucket platforms, according to applicant's knowledge, have not previously been provided with a thermal barrier coating. Thermal barrier coatings per se have been used in the past. See, for example, U.S. Pat. Nos. 6,432,487; 6,047,539; and 5,630,586. As explained in detail below, any number of different types of thermal barrier coatings may be utilized in the present invention. For example, the yttria stabilized zirconia disclosed in U.S. Pat. No. 6,432,487 may be used. Typically, thermal barrier coatings are applied by a plasma spraying process usually in a number of layers and to a required thickness.

[0011] It will be appreciated that there is a well defined interbucket or interplatform face gap which is necessary to be maintained to preclude arch binding of the buckets. That is, the buckets will tend to bind and distort when the buckets are subjected to high operating temperatures absent a gap between buckets in their cold condition. To meet that requirement as well as to reduce the distress of the metal forming the side edges, i.e., slash faces of the platforms, the side faces are provided with a thermal barrier coating. To accomplish this, a groove 26 is formed along each of the opposite side edges of the platform. As illustrated in FIG. 2, the groove 26 opens through the upper surface of the platform. To apply the thermal barrier coating to the opposite side edges, i.e., slash faces of the platform, a bond coat 28 is first applied to the bare metal to enhance the adhesion between the metal surface of the bucket platform and the thermal barrier coating. The bond coat 28 may comprise any available coating such as an oxidation resistance alloy such as MCrAlY where M is iron, cobalt and/or nickel or from a diffusion aluminide or platinum aluminide.

[0012] Once the bond coating has been applied, the thermal barrier coating 30 is applied, preferably by plasma spraying the thermal barrier casting onto the bond coating, and preferably to a thickness which extends an outer portion of the thermal barrier coating beyond the side faces of the non-coated metal portions of the platform. The outer portion of the thermal barrier coating is then abraded or ground to remove a portion of the outer surface of the coating such that the thermal barrier coating lies flush with the remaining metal portions of the platform side faces. The grinding or abrading of the thermal barrier coating enables the designed interbucket side face gap to be maintained while simulta-
neously enabling the remaining thermal barrier coating to afford substantial resistance to distress as a result of the high temperatures to which the bucket is exposed during operation.

[0013] Thus, the foregoing application of the thermal barrier coating to portions of the side faces of the otherwise bare metal platform protects against oxidation and also reduces the thermal gradient during transients for the slash faces relative to the thin platform. The thermal barrier coating effectively reduces the heat flux from the hot gas path air which is ingested between bucket platforms.

[0014] While the present invention is applicable to turbine buckets in general, it is particularly applicable to steam cooled buckets where there is a lack of film cooling on upstream airfoils. Thus, the present invention is particularly applicable to closed loop steam cooled buckets but is also applicable to air-cooled buckets. Also, with backside cooling of the platform, the bond coat interface temperature has the potential for being lowered to levels which would preclude oxidation and enhance long term adhesion of the ceramic thermal barrier coating is the metal.

[0015] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A bucket for a turbine comprising:
   an airfoil, a root and a platform intermediate said airfoil and said root, said platform having generally circumferentially facing side faces for registration with generally corresponding side faces of adjacent buckets;
   each of said platform side faces having a groove therein opening circumferentially outwardly through said side faces; and
   a thermal barrier coating in said grooves and exposed along the side faces of the platform.

2. A bucket according to claim 1 including a bond coat between the side faces of said platform and the thermal barrier coating to facilitate adherence of the thermal barrier coating and the platform side faces to one another.

3. A bucket according to claim 1 wherein said thermal barrier coating lies generally flush with remaining portions of the side faces.

4. A bucket according to claim 1 wherein a surface of the platform forming part of a hot gas path through the turbine includes a thermal barrier coating, the thermal barrier coating on the surface and side faces forming continuations of one another.

5. A bucket according to claim 1 wherein the groove opens outwardly through said surface of the platform.

6. A method of protecting side faces of a platform of a turbine bucket comprising the steps of:
   forming a groove along a side face of the platform opening circumferentially outwardly through said side faces;
   applying a bond coat to the groove;
   applying a thermal barrier coating to the bond coating; and
   removing a portion of the thermal bond coating along said side face to render side face portions having the applied thermal barrier coating thereon and bare metal to lie flush with one another.

7. A method according to claim 6 wherein the step of removing includes abrading the thermal barrier coating.

8. A method according to claim 6 including applying the bond coating and the thermal barrier coating to the platform surface to form a continuous thermal barrier coating surface along the platform surface and at least portions of the side faces.

9. A method according to claim 6 including applying the thermal bond coating to a thickness wherein a portion thereof projects beyond uncoated remaining portions of said platform side face, and removing said projected portion to leave a thermal bond coating surface substantially flush with said uncoated remaining portions of the platform side face.

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