Claims

1. A thermal barrier modified composite coating, comprising:

a first coating layer bonded to a surface of a gas turbine blade having a roughness Ra of less than 3.18 μm (125 μin), said first coating layer comprising macro columnar features characterized by a predetermined distribution of peaks and valleys at their corresponding free surfaces to create improved mechanical bonding between the first layer and a second layer; said second layer being a dense columnar coating or a Densely Vertically Cracked coating being less columnar than the first coating layer;

said macro columnar features comprising microstructural features that include nano-sized and/or submicron-sized splats derived from a precursor liquid suspension to form a thermomechanical compliant interface at the substrate surface, said splats being randomly oriented to produce an isotropic crystallographic orientation for the first coating; said precursor liquid suspension formed by a suspension plasma spray (SPS) method;

said splats comprising non-equiaxed columnar grains that grow opposite to a direction of heat flow upon cooling to produce an anisotropic crystallographic grain orientation; and

wherein said second coating layer is bonded to the corresponding free surfaces of the first coating layer, said second coating layer at the bulk and/or free surface having at least one improved coating property in comparison to the first coating layer, said improved coating property comprising a lower porosity than that of the first coating layer and an improved mechanical erosion barrier in comparison to the first coating layer.

2. The thermal barrier modified composite coating of claim 1, wherein at least a portion of said peaks and valleys have a non-uniformity in width and height to form an interfacial boundary with tortuosity.

3. The thermal barrier modified composite coating of claim 1, wherein said coating property is graded in a continuous manner within said second coating layer, wherein said coating property has a first value at first location adjacent to the interface of the first and the second coating layer, said property changing from said first value along a path starting at said first location and extending in a direction towards a point on the free surface of the second coating layer.

4. The thermal barrier modified composite coating of claim 1, wherein said coating property has a first value at a first location adjacent to the surface of the substrate and a second value at a point along a free surface of said second coating layer, wherein said coating property changes from said first value to said second value in a discrete manner.

5. The thermal barrier modified composite coating of claim 1, wherein said first coating layer comprises microstructural features of less than about 25 microns.

6. The thermal barrier modified composite coating of claim 1, wherein said first coating layer comprises microstructural features ranging from about 10 microns to about 50 nm.