damage mechanism is the corrosion of the outlet edge of the combustion chamber tile element, caused by thermal stresses. In the case of a second damage mechanism, local temperature peaks cause the APS thermal barrier layer on the surface facing the combustion chamber to chip, resulting in planar wear of the base material.

In order to solve this problem, monocrystal base materials are sometimes used today. The disadvantage of this solution is the high outlay for producing the monocyrstals and the associated high production costs.

Aspects of the invention are defined in the independent claims. Further preferred embodiments of the invention can be found in the dependent claims, the drawing and the associated description.

According to the basic concept of the disclosure, a flow element for fluidic contact with a hot gas flow inside an aircraft engine is proposed, the flow element comprising a base material that comprises a hot gas surface that faces the gas flow, and a remote surface that is remote from the gas flow, the base material being completely surrounded by a chroming layer on the hot gas surface and on the remote surface, the flow element comprising an adhesive layer on the chroming layer in first portions, the flow element comprising an alitising layer, the alitising layer being arranged on the adhesive layer in the first portions, a thermal barrier layer being arranged on the alitising layer in the first portions, and the alitising layer being arranged on the chroming layer in second portions that do not comprise an adhesive layer, the chroming layer and the alitising layer forming a chroming-alitising layer in the second portions.

Thus, it may be possible to provide a flow element and a method for the coating thereof, by means of which the hot-gas corrosion resistance is increased at low coating costs.

The flow element is preferably cuboid, such that the hot gas surface is preferably formed by a first lateral surface of the cuboid which faces the gas flow when mounted. The remote surface is then preferably formed by the remaining five lateral surfaces of the cuboid. However, the disclosure of this application explicitly also includes flow elements that have a geometry different from a cuboid. The flow element is preferably formed by a combustion

chamber element of a combustion chamber of a gas turbine, more preferably by a combustion chamber tile element.

The aim of the coating is to set the Al content so as to be as low as possible and to thus increase the resistance to cracking induced by thermo-mechanical fatigue (TMF). In addition, the coating increases the Cr content in the edge region of the base material, as a result of which the resistance to sulphate-induced corrosion is increased. This adjustment of the Al and Cr content can increase the service life of the flow element. This results in increased system reliability and reduced maintenance costs. The chroming layer or the chroming-alitising layer preferably has a Cr content of at most 40 wt.%, more preferably at most 35 wt.%, particularly preferably at most 30 wt.%. The lower limit for the Cr content is preferably at least 10 wt.%, more preferably at least 20 wt.%, particularly preferably at least 30 wt.%.

The chroming layer is preferably applied by means of chemical vapour deposition (CVD). In this case, the chromium preferably diffuses 150 µm into the base material, more preferably approximately 100 µm. In the case of the chroming-alitising layer, aluminium is in addition vaporised by means of chemical vapour deposition (CVD). In this case, the aluminium preferably diffuses 150 µm into the base material, more preferably approximately 100 µm.

The alitising layer in the first portions may also be formed by a platinum aluminide coating, by means of which higher resistance to oxidation can be achieved.

The platinum is then preferably applied to the adhesive layer galvanically or by PVD, alitising subsequently taking place. The platinum aluminide coating forms as a result of the aluminium diffusing in during the alitising. The alitising during the application of the platinum aluminide coating means that said coating is to be understood as an alitising layer within the meaning of claim 1.

The hot gas surface facing the gas flow can in particular be damaged by local temperature peaks caused by what are known as dilution jets. Arranging the chroming layer, the adhesive layer and the alitising layer between the base material and the thermal barrier layer forms a particularly heat-resistant protective layer.

The adhesive layer arranged between the chroming layer and the alitising layer is preferably formed by MCrAlY.

The thermal barrier layer is preferably a ceramic thermal barrier layer, for example consisting of zirconium oxide (ZrO_2). Alternatively, however, one or more thermal barrier layers having different chemical compositions are also possible.

The thermal barrier layer is preferably applied by means of thermal spraying. The thermal barrier layer is more preferably applied by means of physical vapour deposition (PVD) using an electron beam (EB-PVD).

Without the chroming layer, adhesive layer and alitising layer, chipping of the thermal barrier layer would result in planar wear of the base material. The particular advantage of this embodiment is therefore that, after the thermal barrier layer has chipped, the base material is additionally protected by the compound structure consisting of the chroming layer, adhesive layer and alitising layer.

It is furthermore proposed for the first portions to be assigned to the hot gas surface. The coating of the first portions therefore faces the hot gas flow which highly stresses the flow element. The first portions can thus shield the base element from the high thermal stress as far as possible.

Accordingly, the second portions are assigned to the surface remote from the hot gas flow. As a result, the chroming-alitising layer is provided on a surface of the base material that is remote from the gas flow, as a result of which the less highly stressed lateral surfaces, remote from the gas flow, are also adequately protected.

An outlet edge formed by the lateral surfaces remote from the gas flow is also subjected to particularly high stresses adjacently to the hot gas surface. The outlet edge is preferably the edge around which the gas flow passing by flows last. Alternatively, in other words, the outlet edge forms the trailing edge of the flow element in the flow direction.

The high thermal stresses mean that equidistant, lateral cracks may form on the outlet edge. Furthermore, in specific flight conditions, the outlet edge is subjected to sulphate-induced corrosion. The cracks in the coating make it easier for corrosive media to access the base

material, with the result that the combustion chamber tile element that is damaged at the outlet edge has to be replaced by new material. Applying the chroming-alitising layer to the outlet edge of the flow element makes it possible to reliably prevent this damage mechanism.

It is furthermore proposed for the Cr content to be higher than the Al content in the case of the chroming-alitising layer. This adjustment of the proportions of Al and Cr achieves sufficiently high resistance to the cracking induced by thermal stress.

In the case of the chroming-alitising layer, it is furthermore preferable for the Al content to be less than 20 wt.%, preferably less than 15 wt.%, more preferably at most 10 wt.%. In the case of the chroming-alitising layer, the lower limit for the Al content is preferably at least 5 wt.%, more preferably at least 10 wt.%.

A method for coating a flow element for an aircraft engine is also proposed, the flow element comprising a base material, the base material of the flow element being completely coated with a chroming layer in a first method step, the chroming layer being coated in part with an adhesive layer in a second method step, and the chroming layer and the adhesive layer being completely coated with an alitising layer in a third method step.

It is furthermore proposed for partial coating with a thermal barrier layer to take place in a fourth method step.

The coating of the second method step and of the fourth method step is preferably carried out in the same portions. This ensures that the adhesive layer is provided at the points at which the thermal barrier layer is provided.

It has furthermore been found to be advantageous for the first method step to be carried out by means of chemical vapour deposition and/or for the second method step to be carried out by means of thermal spraying and/or for the third method step to be carried out by means of chemical vapour deposition. The fourth method step is preferably carried out by means of thermal spraying or by means of physical vapour deposition using an electron beam.

The invention will be explained in the following, by way of non-limiting example only, and with reference to preferred embodiments and to the accompanying drawing, in which:

Fig. 1 is a cross sectional view of a flow element according to the invention.

Fig. 1 is a cross sectional view of an embodiment of a flow element 1 according to the invention. The flow element 1 preferably forms a combustion chamber element of a combustion chamber in an aircraft engine, more preferably a combustion chamber tile element. The core of the flow element 1 according to the invention is formed by a base material 2. Nickel- and cobalt-based superalloys, for example, are possible as the material for the base material 2.

If the flow element 1 is formed by a combustion chamber tile element, when mounted said element is screwed to a metal housing and protects said housing from the temperatures emitted during the combustion process which flow past the flow element 1 in a hot gas flow 15.

The gas flow 15 of the combustion gases is indicated by an arrow in Fig. 1, the flow direction of the gas flow 15 being indicated by the arrow direction.

The basic shape of the flow element 1 is preferably cuboid, although other geometries are also possible. When installed, a distinction is made between a hot gas surface 12 facing the gas flow 15 and a surface 16 remote from the gas flow 12, the remote surface 16 preferably comprising five lateral surfaces: a first lateral surface 6 that is oriented counter to the flow direction of the gas flow 15 and that forms an inlet edge 8; a second lateral surface 17 that faces in the flow direction and that forms an outlet edge 7; a third lateral surface 18 that is arranged opposite the hot gas surface 12 facing the gas flow 15 and that forms a rear face 11; and two lateral surfaces that are in parallel with the sectional plane of Fig. 1 and that are referred to as lateral edges.

Pins that are preferably orthogonal to the third subsurface 18 may be provided on the rear face 11 of the flow element 1, which pins increase the surface area on the rear face 11. The heat transfer to a cooling air mass flow that flows between the metal housing and the rear face 11 can thus be improved. The coating of the third protruding pins, if present, is also to be understood as a coating of the rear face 11.

Claims

1. Flow element (1) for fluidic contact with a hot gas flow (15) inside an aircraft engine,
- the flow element (1) comprising a base material (2) that comprises a hot gas surface (12) that faces the gas flow (15), and a remote surface (16) that is remote from the gas flow (15), characterised in that
- the base material (2) is completely surrounded by a chroming layer (3) on the hot gas surface (12) and on the remote surface (16),
- the flow element (1) comprising an adhesive layer (13) on the chroming layer (3) in first portions,
- the flow element (1) comprising an alitising layer (5),
- the alitising layer (5) being arranged on the adhesive layer (13) in the first portions,
- a thermal barrier layer (14) being arranged on the alitising layer (5) in the first portions, and
- the alitising layer (5) being arranged on the chroming layer (3) in second portions that do not comprise an adhesive layer (13), the chroming layer (3) and the alitising layer (5) forming a chroming-alitising layer (4) in said second portions.

2. Flow element (1) according to claim 1, characterised in that the first portions are assigned to the hot gas surface (12).

3. Flow element (1) according to either of the preceding claims, characterised in that, in the case of the chroming-alitising layer (4), the Cr content is higher than the Al content.

4. Flow element (1) according to any of the preceding claims, characterised in that, in the case of the chroming-alitising layer (4), the Al content is less than 20 wt.%.

5. Method for coating a flow element (1) for an aircraft engine, the flow element (1) comprising a base material (2), characterised in that,
- in a first method step, the base material (2) of the flow element (1) is completely coated with a chroming layer (3),
- in a second method step, the chroming layer (3) is coated in part with an adhesive layer (13),
- in a third method step, the chroming layer (3) and the adhesive layer (13) are completely coated with an alitising layer (5).

6. Method according to claim 5, characterised in that, in a fourth method step, partial coating with a thermal barrier layer (14) is carried out.

7. Method according to claim 6, characterised in that the coating of the second method step and of the fourth method step is carried out in the same portions.

8. Method according to any of claims 5 to 7, characterised in that the first method step is carried out by means of chemical vapour deposition.

9. Method according to any of claims 5 to 8, characterised in that the second method step is carried out by means of thermal spraying.

10. Method according to any of claims 5 to 9, characterised in that the third method step is carried out by means of chemical vapour deposition.

11. Method according to any of claims 6 and 7, characterised in that the fourth method step is carried out by means of thermal spraying or by means of physical vapour deposition using an electron beam.