solidified and single crystal superalloys at an ambient temperature that will allow self healing of cracks during welding and post weld heat treatment.

[00021] Embodiments of the present invention seek to develop parameters for a post weld heat treatment (PWHT) for the self healing of cracks during a PWHT.

Brief Description of the Invention

[00027] According to an aspect of the present invention, there is provided a method of cladding and fusion welding of superalloys comprises the steps of: application of a composite filler powder that comprises 5-50% by weight brazing powder which includes melting point depressants, and 50-95% by weight high temperature welding powder, to a superalloy base material; simultaneous heating of the base material and the composite filler powder by a welding heat source that is movable relative to the base material, to a temperature that fully melts the brazing powder and at least partially melts the high temperature welding powder and also melts a surface layer of the base material, thereby forming a welding pool; cooling of the welding pool with a sufficient speed such that upon solidification and cooling, a composite structure that comprises an interconnected framework of high melting temperature dendrites produced by the high temperature welding powder and an interdendritic eutectic matrix in ~~the~~ a weld bead is formed by the brazing powder and the welding powder and the base material; and post weld heat treatment at a temperature exceeding a solidus temperature of the brazing powder and below a solidus temperature of the high temperature welding powder, that results in at least a partial re-melting of the eutectic that fills cracks in the weld bead and the base material by capillary action followed by cooling and consolidation of the weld bead.

[00027a] An embodiment of the method of cladding and fusion welding includes the steps of an application of a composite filler powder containing 5-50% brazing powder

Claims:

1. A method of cladding and fusion welding of superalloys comprises the steps of:

   a. application of a composite filler powder that comprises 5-50% by weight brazing powder which includes melting point depressants, and 50-95% by weight high temperature welding powder, to a superalloy base material;

   b. simultaneous heating of the base material and the composite filler powder by a welding heat source that is movable relative to the base material, to a temperature that fully melts the brazing powder and at least partially melts the high temperature welding powder and also melts a surface layer of the base material, thereby forming a welding pool;

   c. cooling of the welding pool with a sufficient speed such that upon solidification and cooling, a composite structure that comprises an interconnected framework of high melting temperature dendrites produced by the high temperature welding powder and an interdendritic eutectic matrix in ~~the~~ a weld bead is formed by the brazing powder and the welding powder and the base material; and

   d. post weld heat treatment at a temperature exceeding a solidus temperature of the brazing powder and below a solidus temperature of the high temperature welding powder, that results in at least a partial re-melting of the eutectic that fills cracks in the weld bead and the base material by capillary action followed by cooling and consolidation of the weld bead.

2. Method of cladding and fusion welding as per claim 1, wherein the ratio of the length of the welding pool in inches to the welding speed in inches/minute is selected to fall between 0.002 - 0.02.

3. Method of cladding and fusion welding as per claim 1, wherein the brazing powder is fully melted while the high temperature welding powder is heated to a temperature below its liquidus temperature.

4. Method of cladding and fusion welding as per claim 1, wherein the composite filler powder is heated during welding by the heat source to a temperature exceeding the melting temperature of the brazing powder but below 1.2 times the melting temperature of the high temperature welding powder.

~~5. Method of cladding and fusion welding as per claim 3, wherein the composite filler powder is heated during welding by the heat source to a temperature exceeding the melting temperature of the brazing powder but below 1.2 times the melting temperature of the high temperature welding powder.~~

~~6~~5. Method of cladding and fusion welding as per claim 1, wherein the high temperature welding powder consists of in wt. % the following chemical elements:

Co 9-15%;

Al 3-6.5%;

C 0.1-0.2%;

Ti, Zr and Hf with a total content from 1 to 8.5%;

Ta and Nb with a total content from 0.5 to 8.5%;

W and Mo with a total content from 7 to 20 %;

Cr and Re with a total content from 6.5 to 18.5 %;

Fe and Mn with a total content from 0.1 to 1 %;

Ni and impurities to balance.

~~7~~6. Method of cladding and fusion welding as per claim 1 wherein the post weld heat treatment includes an additional second step of an aging heat temperature of the base material.

~~8~~7. Method of cladding and fusion welding as per claim 1, wherein the melting point depressant in the brazing powder consists of Si in the amount of approximately 1 to 10 weight % of the brazing powder.

~~98~~. Method of cladding and fusion welding as per claim 1, wherein the melting point depressant in the brazing powder consists of B in the amount of approximately 0.2 to 4 weight % of the brazing powder.

~~109~~. Method of cladding and fusion welding as per claim 1, wherein the melting point depressant in the brazing powder consists of a preselected mixture B and Si in ~~the~~ a total amount of approximately 1.2 to 10 weight % of the brazing powder wherein the B content remains less than approximately 4 weight %.