Another mechanism by which powders may aggregate is by compression of powders comprising ductile phases such that the ductile phases are deformed to cause cold welding of the particles. Deformation may be impeded by providing low ductility powders, particularly powders that have a low free metal content such as less than 15%, or less than 10%, or less than 5% or less than 2% or less than 1% or less than 0.5% by volume

Yet another mechanism by which powders may aggregate is by interlocking to form a mechanical bond. Interlocking may be impeded by providing powders that approximate spherical in form, having a low aspect ratio such as less than 4:1, or less than 2:1, or less than 3:2.

Interlocking may also be impeded by providing powders that have a relatively smooth surface, for example such as having a convexity of greater than 0.7, preferably greater than 0.8, more preferably greater than 0.9. Convexity is conventionally calculated by calculating a convex hull perimeter for an image of the particle [typically presented by the analogy of an imaginary elastic band encompassing the projection of the particle on to a 2D surface, such is provided by the particle image]; measuring the actual perimeter of the particle; and determining convexity by the formula:-

Convexity = convex hull perimeter/actual perimeter

According to a first aspect of the present invention, there is provided a brazing alloy wire formed from a composite comprising a sheath of at least one ductile first phase and a core comprising particles of a different composition to the sheath, in which:- the sheath has an annealing temperature in degrees K; the particles have a melting point at least 20% above the annealing temperature of the sheath; the particles have a size distribution in which 25% by weight or less comprise particles less than 25μm in size; the particles are discrete; the particles have a free metal content of less than 10% by volume; the particles have a convexity greater than 0.7; the particles have an aspect ratio of less than 4:1; the overall composition of the composite being equivalent to a low ductility alloy composition.

According to a second aspect of the present invention, there is provided a method, for forming the above blazing alloy wire, comprising:- a) providing a preform of a composite comprising a sheath of the at least one ductile first phase and a core comprising particles of a different composition to the sheath, in which:- the sheath has an annealing temperature in degrees K; the particles have a melting point at least 20% above the annealing temperature of the sheath; the particles have a size distribution in which 25% by weight or less comprise particles less than 25μm in size; the particles are discrete; the particles have a free metal content of less than 10% by volume; the particles have a convexity greater than 0.7; the particles have an aspect ratio of less than 4:1; the overall composition of the composite being equivalent to a low ductility alloy composition; and b) in two or more reduction steps, reducing the preform in diameter while increasing the length of the preform to form the wire; and in which one or more annealing steps are provided between the two or more reduction steps to restore ductility to the sheath.

According to a third aspect of the present invention, there is provided a method of furnace brazing comprising the use of the above blazing alloy wire to join parts to form an article.

According to a fourth aspect of the present invention, there is provided an article comprising a brazed joint produced by the above method.

By "ductile first phase" is meant a phase of sufficient ductility to permit drawing as a wire to reduction in diameter of 5% or more using conventional wire drawing apparatus. Such a reduction is sufficient to permit at least one practical reduction and following with further reductions by sequentially annealing the material at each reduction step.

Claims

1. Brazing alloy wire formed from a composite comprising a sheath of at least one ductile first phase and a core comprising particles of a different composition to the sheath, in which:-

- the sheath has an annealing temperature in degrees K
- the particles have a melting point at least 20% above the annealing temperature of the sheath
- the particles have a size distribution in which 25% by weight or less comprise particles less than 25μm in size
- the particles are discrete
- the particles have a free metal content of less than 10% by volume
- the particles have a convexity greater than 0.7
- the particles have an aspect ratio of less than 4:1

the overall composition of the composite being equivalent to a low ductility alloy composition.

2. Brazing alloy wire as claimed in Claim 1, in which the particles have an aspect ratio of less than 2:1, or less than 3:2

3. Brazing alloy wire as claimed in any of Claims 1 to 2, in which the particles have a melting point at least 30% above the annealing temperature of the sheath, or at least 40% above the annealing temperature of the sheath.

4. Brazing alloy wire as claimed in any of Claims 1 to 3, in which the particles are low ductility particles.

5. Brazing alloy wire as claimed in Claim 1, in which the particles have a convexity greater than 0.8, or greater than 0.9.

6. Brazing alloy wire as claimed in any of Claims 1 to 5, in which the low ductility composition is an alloy selected from the group comprising aluminum based alloys, magnesium based alloys, copper based alloys, silver based alloys, gold based alloys, palladium based alloys, nickel based alloys, and cobalt based alloys.

7. Brazing alloy wire as claimed in any of Claims 1 to 6 in which the brazing alloy wire is an annealed wire.

8. Brazing alloy wire as claimed in any of Claims 1 to 6, in which the wire is in the form of a ring.

9. Brazing alloy wire as claimed in any of Claims 1 to 8, in which the wire has a diameter of less than 1mm, or less than 0.5mm, or less than 0.25mm.

10. A method, for forming a brazing alloy wire as claimed in any of Claims 1 to 9, comprising:-

a) providing a preform of a composite comprising a sheath of the at least one ductile first phase and a core comprising particles of a different composition to the sheath, in which:-

- the sheath has an annealing temperature in degrees K
- the particles have a melting point at least 20% above the annealing temperature of the sheath
- the particles have a size distribution in which 25% by weight or less comprise particles less than 25μm in size
- the particles are discrete
- the particles have a free metal content of less than 10% by volume
- the particles have a convexity greater than 0.7
- the particles have an aspect ratio of less than 4:1

the overall composition of the composite being equivalent to a low ductility alloy composition;

and

b) in two or more reduction steps, reducing the preform in diameter while increasing the length of the preform to form the wire;

and

in which one or more annealing steps are provided between the two or more reduction steps to restore ductility to the sheath.

11. A method as claimed in Claim 10, in which the two or more reduction steps comprise one or more swaging steps.

12. A method as claimed in Claim 10 or Claim 11, in which the two or more reduction steps comprises one or more roll drawing steps.

13. A method as claimed in any of Claims 10 to 12, in which the two or more reduction steps comprises one or more deep drawing steps.

14. A method as claimed in any of Claims 10 to 13, in which the two or more reduction steps comprises a combination of two or more different reduction steps selected from the group swaging, roll drawing and deep drawing.

15. A method as claimed in any of Claims 10 to 14, in which the material of the preform is degassed prior to the one or more reduction steps.

16. A method as claimed in any of Claims 10 to 15, in which the one or more ductile first phases are present in proportions sufficient to permit drawing of the composite to a reduction in diameter of 5% or more.

17. A method of furnace brazing comprising the use of a brazing alloy wire as claimed in any of Claims 1 to 9 to join parts to form an article.

18. An article comprising a brazed joint produced by the method of Claim 17.