(54) Title: ELECTRICAL CONNECTION TAPE

(57) Abstract: A thermal managing electrical connection tape includes a carrier film and a composition including solder powder, with the composition being applied to the carrier film. The composition includes a soldering flux having the solder powder disposed therein. The composition contains between about 50 wt % and about 70 wt % soldering flux. The composition further contains between about 30 wt % and about 50 wt % solder powder. A method of fabricating a thermal managing electrical connection tape includes providing a composition including at least one of a soldering flux and epoxy and/or acrylic, adding a solder powder to the composition, casting the composition on a carrier film, drying the carrier film in a drying furnace to form a dried tape, and cutting the dried tape to a desired width to form a thermal managing electrical connection tape.
before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(b))
ELECTRICAL CONNECTION TAPE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Application Serial No. 62/114,820, titled “ELECTRICAL CONNECTION TAPE,” filed Feb. 11, 2015, which is incorporated herein by reference in its entirety.

BACKGROUND OF THE DISCLOSURE

The present disclosure is directed to materials for joining electrical or mechanical components, and more particularly to materials for attaching electronic components and associated devices onto electronic substrates.

As electronic devices become more advanced, the ability to quickly connect increasingly fine pitched metalized features among combinations of substrates is becoming increasingly difficult. Traditionally, depending on substrate type, these connections have been produced by screen printing solder paste or anisotropic conductive paste (ACP), applying anisotropic conductive film (ACF), or by use of preforms, wave soldering, wire bonding, or solder wire. However, each of these methods has individual drawbacks. Screen printing technology is pitch limited and not applicable in many applications, such as flex attach. ACF is highly pressure dependent, offers only a low current carrying capacity connection, degrades over time, and is costly to manufacture. Preforms need to be placed in or around solder deposits to keep them in position during processing. Wave soldering requires large amounts of energy and is not applicable in many attach applications. Wire bonding is a relatively slow and costly process with high reliability issues for many applications. Lastly, solder wire is also a slow process and is prone to splattering flux or solder to unwanted areas of a substrate.

SUMMARY

One aspect of the present disclosure is directed to a thermal managing electrical connection tape comprising a carrier film and a composition including solder powder, with the composition being applied to the carrier film.

Embodiments of the tape further may include providing a soldering flux in the composition, with the soldering flux having the solder powder disposed therein. The
composition may contain between about 50 wt % and about 70 wt % soldering flux. The composition further may contain between about 30 wt % and about 50 wt % solder powder. The composition may be patterned with epoxy and/or acrylic. The composition may include at least one of epoxy and acrylic. The composition may include “suction cup” morphology. The composition may include filler materials that increase reliability at high pressures. The filler material may include glass frit. The composition further may include additives for process temperature and residue evaluations. The additives may include at least one of Leuco, Leuco-like, and liquid crystal “thermochromic” dyes.

Another aspect of the present disclosure is directed to a method of fabricating a thermal managing electrical connection tape. In one embodiment, the method comprises: providing a composition including at least one of a soldering flux and epoxy and/or acrylic; adding a solder powder to the composition; casting the composition on a carrier film; drying the carrier film in a drying furnace to form a dried tape; and cutting the dried tape to a desired width to form a thermal managing electrical connection tape.

Embodiments of the method further may include the composition having about 10 wt % to about 70 wt % solder powder. The composition further may include about 30 wt % to about 90 wt % soldering flux. Drying the tape in a drying furnace may include drying the tape at 10-15 °C below a boiling point of a solvent of the composition for 5-15 minutes.

Another aspect of the present disclosure is directed to a method of fabricating an assembly comprising a thermal managing electrical connection tape. In one embodiment, the method comprises: laminating a tape between two substrates containing metallization to be connected, the tape including a resilient carrier film and a composition having soldering flux and solder powder applied to the carrier film; heating the laminated tape and substrates to a melting temperature of the solder powder; as the temperature raises, melting the carrier film on which the composition is applied; once bulk melting of the carrier film has begun, the soldering flux deoxidizes and acts as a transport mechanism for the solder powder; when the melting temperature is reached, the deoxidized solder wets only the substrate metallization, and stranded solder powder is transported by a liquid flux to a desired metallization area; and cooling the tape.

Embodiments of the method further may include laminating of the tape between the two substrates at a temperature 90-187 °C and a pressure 0.02-33 psi for 1-10 seconds. The melting temperature of the solder powder is between 137-289 °C.
BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a tape of an embodiment of the present disclosure;
FIG. 2 is a schematic view of a tape of another embodiment of the present disclosure;
FIG. 3 is a schematic view of a tape having suction cup morphology of another
embodiment of the present disclosure;
FIG. 4 is a schematic view of a tape of another embodiment of the present disclosure;
FIG. 5 is a schematic view of a tape of another embodiment of the present disclosure;
FIG. 6 is a schematic view of a tape of another embodiment of the present disclosure; and
FIG. 7 is a diagram showing use of thermal managing electrical connection tape.

DETAILED DESCRIPTION

This invention is not limited in its application to the details of construction and the
arrangement of components set forth in the following description or illustrated in the drawings.
The invention is capable of embodiments and of being practiced or of being carried out in
various ways beyond those exemplarily presented herein.

Thermal managing electrical connection tape of embodiments of the present disclosure is
designed to take advantage of a metal’s affinity for other metals. A thermal managing electrical
connection tape of embodiments of the present disclosure includes a resilient film having a flux
composition, including soldering flux and a solder powder, applied to the film. The tape is
laminated (or pressed in place) between two substrates containing metallization to be connected.
In certain embodiments, the substrates can be fabricated from any suitable metal, such as copper,
silver, tin, gold, etc. The thermal managing electrical connection tape, sometimes referred to as
“TMECT,” is then heated in accordance with a temperature profile that reaches a melt
temperature of the particular metal or alloy used in the substrate. In certain embodiments, the
temperatures and the times are dependent on the metal or alloy used, the film thickness and the
type of substrate. For example, the temperature to be applied can be 10-20 ºC above the melting
temperature of the metal or alloy, and the duration can be between 20-30 seconds. As the
temperature rises, the tape having the resilient carrier film and the soldering flux/solder powder
composition melts. Once bulk melting has begun, the flux both deoxidizes and acts as a
transport mechanism for the solder. When the solder alloy melt temperature is reached, the
deoxidized solder wets only the substrate metallization, and the stranded solder is transported by the liquid flux to the desired metallization areas. After the solder has been transported to the metallization, the entire sample is allowed to cool. The final product is two substrates electrically connected on the metalized areas only, and contains completely electrically isolated connections.

Referring to FIG. 1, a thermal managing electrical connection tape is generally indicated at 100, and includes a resilient film 120 having a soldering flux composition 110 applied to the film. As shown, the flux composition 110 includes a soldering flux and a solder powder 140 incorporated or embedded within the soldering flux. In some embodiments, the film 120 may include a carrier film suitable for material applications. The flux composition 110 may include a solvent, polymer, an activator, a rosin or resin, a corrosion inhibitor, or combinations of these constituents. In some embodiments, the solvent may be methylcyclohexane or ethanol. In some embodiments, the polymer may be Versamid® 940 or Polyvinylpyrrolidone (PVP). In some embodiments, the activator may be a dicarboxylic acid such as adipic acid or may be dibromobutadiol, or iodobenzoic acid, or cyclohexylamine HCl. In some embodiments, the resin may be, for example, Dymerex. In some embodiments, the corrosion inhibitor may be, for example, benzotriazole.

The solder powder 140 is compatible with the soldering flux of the flux composition 110. In some embodiments, solder powder 140 may include a lead-free solder. In some embodiments, solder powder 140 may include a mixture of tin, silver, and copper. For example, solder powder 140 may include SAC305 solder alloy. Solder powder 140 may include particles of any size compatible with the application. For example, solder powder 140 may include Type 3 particle sizes of 25 μm to 45 μm. Any suitable solder compatible with the flux composition 110 can be provided.

The flux composition 110 and the solder powder 140 may be in any mixture composition. The composition may vary depending on the end application. In some embodiments, the flux composition 110 may include about 10 wt % to about 70 wt % solder powder 140 and about 30 wt % to about 90 wt % soldering flux. In other embodiments, the composition 110 may include about 30 wt % to about 50 wt % solder powder 140 and about 50 wt % to about 70 wt % soldering flux. For example, the flux composition 110 may include a slurry containing about 40 wt % solder powder 140 and about 60 wt % soldering flux. The slurry may be cast on the film.
120, dried in a drying furnace and slit to the desired film width to create a TMECT. For example, the drying temperature may be approximately 10-15 °C below a boiling point of the solvent for approximately 5-15 minutes, depending on the cast thickness.

Referring to FIG. 2, a TMECT, generally indicated at 200, can also be patterned with epoxy and/or acrylic 250, which is interspersed within the flux composition 110. The patterned epoxy and/or acrylic TMECT 200 is designed to add strength and the ability to increase a bond line of a processed substrate. The epoxy and/or acrylic TMECT 250 may also limit solder shorting potential.

Referring to FIG. 3, a TMECT, generally indicated at 300, can be processed to construct “suction cup” morphology, indicated at 350, which is formed on a bottom of the tape. The suction cup morphology 350 can eliminate a typical lamination step required for anisotropic conductive films by making the tape 300 able to be initially pressed and fixed to its desired substrate without added heat.

Referring to FIG. 4, a TMECT, generally indicated at 400, may contain filler materials, such as glass frit 450, to make the process more reliable at higher pressures.

Referring to FIG. 5, a TMECT, generally indicated at 500, may also contain additives 550, such as Leuco, Leuco-like, or liquid crystal “thermochromic” dyes for process temperature and residue evaluations.

The tapes 100, 200, 300, 400, 500 of FIGS. 1-5, respectively, contrast with anisotropic conductive paste (ACF), an example of which is shown in FIG. 6. As shown, a tape generally indicated at 600 includes a carrier film 620 and a paste 610 (epoxy and/or acrylic) applied to the film. In one embodiment the paste 610 includes conductive particles 630 embedded in the paste. A typical ACF includes a conducting particle, for example, a polymer plated with layers of Ni/Au, in an epoxy and/or acrylic matrix. ACF can be laminated in place by curing the epoxy and/or acrylic, which essentially glues the film to the substrate. Electrical connections between metalized substrates are then made by applying between 1-100 mPa of pressure (film and substrate dependent) to the substrates, thus crushing the conductive particles between the metallization and creating a low current carrying capacity connection.

In some embodiments, the thermal managing electrical connection tape of embodiments of the present disclosure can be most closely related to the ACF platform, but can be used as a replacement for any of the above-identified compositions and processes. The TMECT is highly
reliable in connecting fine pitched features, does not require pressure, can be directly attached to
the substrate without use of paste, offers a low resistance connection, does not need to be
refrigerated, inexpensive to manufacture and in some instance can eliminate a classic ACF
lamination and standard perform placement process step. The TMECT can also easily be
adapted for standard die attach processes such as Die transfer film (DTF) and wafer backside
(WBS) processing.

FIG. 7 is a process diagram illustrating a method of using thermal managing electrical
connection film as an ACF replacement. The first step 701 includes placing the film on a first
metalized substrate. Next, the film is laminated or pressed onto the first metalized substrate (step
702). The sample is allowed to cool and the laminate backing is removed in step 703. After
cooling, the second metalized substrate is aligned with the first metalized substrate (step 704) to
form an assembly. The assembly is then brought to the alloy melt temperature and held for about
90 seconds (step 705). Finally, the assembly is allowed to cool to room temperature (step 706).

In a certain embodiment, a method of fabricating an assembly comprising a thermal
managing electrical connection tape includes laminating a tape between two substrates
containing metallization to be connected, with the tape including a resilient carrier film and a
composition having soldering flux and solder powder applied to the carrier film. The laminated
tape and substrates is heated to a melting temperature of the solder powder. As the temperature
rises, the carrier film melts on which the composition is applied. Once bulk melting of the
carrier film has begun, the soldering flux deoxidizes and acts as a transport mechanism for the
solder powder. When the melting temperature is reached, the deoxidized solder wets only the
substrate metallization, and stranded solder powder is transported by a liquid flux to a desired
metallization area. Finally, the tape is cooled. Embodiments of the method include laminating
of the tape between the two substrates at a temperature 90-187 °C and a pressure 0.02-33 psi for
1-10 seconds. Melting temperature of the solder powder is between 137-289 °C.

Example
A thermal managing electrical connection tape including a carrier film and a flux
composition having soldering flux and solder powder was prepared. The tape was prepared by
adding 15.5 wt % methylcyclohexane to a glass or stainless steel container with mixing
capability. About 46.6 wt % ethanol was added to the solution and mixed until homogeneous.
Next, about 15.6 wt % of Versamid® 940 was added to the solution, and mixed until the solution was clear. Approximately 9.6 wt % of Dymerex was then added to the solution and again mixed until the solution was clear. Then, about 0.2 wt % iodobenzoic acid was added to the solution and mixed until the solution was clear. About 1.4 wt % of dibromobutendiol was then added to the solution and mixed until the solution was clear. Next, about 0.2 wt % cyclohexylamine HCl was added to the solution and mixed until the solution was clear. About 10.8 wt % adipic acid was then added to the solution and mixed until the solution was clear. Finally, about 0.1 wt % benzotriazole was added to the solution and mixed until the solution was clear.

A solder powder, SAC305 Type 3, was then added to the soldering flux solution to create a slurry comprising about 40 wt % solder powder and 60 wt % flux film. The composition may vary depending on the end application. The slurry was cast with a carrier film into a tape, dried in a drying furnace, and slit to the desired tape width. Depending on the cast thickness, the drying temperature is approximately 10-15 °C below a boiling point of the solvent for approximately 5-15 minutes.

It is to be appreciated that embodiments of the compositions and methods discussed herein are not limited in application to the details of construction and the arrangement set forth herein. The compositions and methods are capable of implementation in other embodiments and of being practiced or of being carried out in various ways. Examples of specific implementations are provided herein for illustrative purposes only and are not intended to be limiting. In particular, acts, elements and features discussed in connection with any one or more embodiments are not intended to be excluded from a similar role in any other embodiment.

Also, the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use herein of “including,” “comprising,” “having,” “containing,” “involving,” and variations thereof is meant to encompass the items listed thereafter and equivalents thereof as well as additional items.
Having described above several aspects of at least one embodiment, it is to be appreciated various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications, and improvements are intended to be part of this disclosure and are intended to be within the scope of the disclosure. Accordingly, the foregoing description and drawings are by way of example only.

What is claimed is:
CLAIMS

1. A thermal managing electrical connection tape comprising:
   a carrier film; and
   a composition including solder powder, the composition being applied to the carrier film.

2. The thermal managing electrical connection tape of claim 1, wherein the composition includes a soldering flux having the solder powder disposed in the soldering flux.

3. The thermal managing electrical connection tape of claim 2, wherein the composition contains between about 50 wt % and about 70 wt % soldering flux.

4. The thermal managing electrical connection tape of claim 3, wherein the composition contains between about 30 wt % and about 50 wt % solder powder.

5. The thermal managing electrical connection tape of claim 2, wherein the composition is patterned with epoxy and/or acrylic.

6. The thermal managing electrical connection tape of claim 1, wherein the composition includes at least one of epoxy and acrylic.

7. The thermal managing electrical connection tape of claim 1, wherein the composition includes “suction cup” morphology.

8. The thermal managing electrical connection tape of claim 1, wherein the composition includes filler materials that increase reliability at high pressures.

9. The thermal managing electrical connection tape of claim 8, wherein the filler material includes glass frit.
10. The thermal managing electrical connection tape of claim 1, wherein the composition further includes additives for process temperature and residue evaluations.

11. The thermal managing electrical connection tape of claim 10, wherein the additives include at least one of Leuco, Leuco-like, and liquid crystal “thermochromic” dyes.

12. A method of fabricating a thermal managing electrical connection tape, the method comprising:
   providing a composition including at least one of a soldering flux and epoxy and/or acrylic;
   adding a solder powder to the composition;
   casting the composition on a carrier film;
   drying the carrier film in a drying furnace to form a dried tape; and
   cutting the dried tape to a desired width to form a thermal managing electrical connection tape.

13. The method of claim 12, wherein the composition includes about 10 wt % to about 70 wt % solder powder.

14. The method of claim 13, wherein the composition includes about 30 wt % to about 90 wt % soldering flux.

15. The method of claim 12, wherein drying the tape in a drying furnace includes drying the tape at 10-15 °C below a boiling point of a solvent of the composition for 5-15 minutes.

16. A method of fabricating an assembly comprising a thermal managing electrical connection tape, the method comprising:
   laminating a tape between two substrates containing metallization to be connected, the tape including a resilient carrier film and a composition having soldering flux and solder powder applied to the carrier film;
heating the laminated tape and substrates to a melting temperature of the solder powder; as the temperature raises, melting the carrier film on which the composition is applied; once bulk melting of the carrier film has begun, the soldering flux deoxidizes and acts as a transport mechanism for the solder powder; when the melting temperature is reached, the deoxidized solder wets only the substrate metallization, and stranded solder powder is transported by a liquid flux to a desired metallization area; and cooling the tape.

17. The method of claim 16, wherein the laminating of the tape between the two substrates is achieved at a temperature 90-187 °C and a pressure 0.02-33 psi for 1-10 seconds.

18. The method of claim 16, wherein the melting temperature of the solder powder is between 137-289 °C.
701  Place tape on first metalized substrate

702  Laminate/press tape on first metalized substrate

703  Allow sample to cool and remove laminate backing

704  Align second metalized substrate with first metalized substrate

705  Bring to alloy melt temperature and hold for 90 seconds

706  Allow to cool to room temperature

FIG. 7
## INTERNATIONAL SEARCH REPORT

### A. CLASSIFICATION OF SUBJECT MATTER

**IPC(8) - H01R 4/00, 4/04; C09J 7/02 (2016.01)**

**CPC - H01R 4/00, 4/04; C09J 7/0242**

According to International Patent Classification (IPC) or to both national classification and IPC.

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**IPC(8): H01R 4/00, 4/04; C09J 7/02, 9/02 (2016.01)**

**CPC: H01R 4/00, 4/04; C09J 7/0242, 7/0246, 7/043**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSeek (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Google Scholar, Ebsco, IEEE

**KEYWORDS:** fabricate, make, construct, manufacture, produce, assemble, solder, alloy, metal, powder, ash, dust, precipitate, triturate, film, carrier, substrate, median, plate, tape, ribbon, strip, TMECT, epoxy, resin, polyepoxides, plastic, adhesive, glue, varnish, soldering

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2002/0056925 A1 (KANG, S et al.) May 16, 2002; figure 3, paragraphs [0007]-[0008], [0023], [0026]-[0030], [0033], [0035], [0036] [0037] &amp; [0044]</td>
<td>1-2, 6, 8 &amp; 10</td>
</tr>
<tr>
<td>Y</td>
<td>WO 98/08362 A1 (CRAIG, H) February 26, 1998; claim 43</td>
<td>5, 7, 9, 11-13</td>
</tr>
<tr>
<td>Y</td>
<td>JP 2015009394 A (KYOTO CERAMIC) January 19, 2015; See machine translation; page 12, paragraph 3, figure 5</td>
<td>7 &amp; 9</td>
</tr>
<tr>
<td>Y</td>
<td>US 2007/0260325 A1 (WENZ, R) November 08, 2007; claim 9</td>
<td>11</td>
</tr>
<tr>
<td>A</td>
<td>US 5,904,782 A (DIEP-QUANG, H) May 18, 1999; claim 11</td>
<td>1-15</td>
</tr>
</tbody>
</table>

\[ ☐\] Further documents are listed in the continuation of Box C.  
\[ ☐\] See patent family annex.

* Special categories of cited documents:

  **"A"** document defining the general state of the art which is not considered to be of particular relevance

  **"E"** earlier application or patent but published on or after the international filing date

  **"L"** document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

  **"O"** document relating to an oral disclosure, use, exhibition or other means

  **"P"** document published prior to the international filing date but later than the priority date claimed

  **"T"** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

  **"X"** document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

  **"Y"** document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

  **"&"** document member of the same patent family

Date of the actual completion of the international search

03 June 2016 (03.06.2016)

Date of mailing of the international search report

**05 JUL 2016**

Name and mailing address of the ISA/

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Shane Thomas

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)
INTERNATIONAL SEARCH REPORT

### Box No. II
**Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
   - because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
   - because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
   - because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box No. III
**Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

***see extra sheet***

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
   - 1-15

**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2015)
INTERNATIONAL SEARCH REPORT

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-15 appear to be directed towards a method of fabricating a thermal managing electrical connection tape.

Group II: Claims 1-11 & 16-18 appear to be directed towards a method of fabricating an assembly comprising a thermal managing electrical connection tape.

The inventions listed as Groups I & II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features.

The special technical features present in Group I are at least providing a composition including at least one of a soldering flux and epoxy and/or acrylic, drying the carrier film in a drying furnace to form a dried tape; and cutting the dried tape to a desired width to form a thermal managing electrical connection tape, which Group II does not have.

The special technical features present in Group II are at least laminating a tape between two substrates containing metallization to be connected; heating the laminated tape and substrates to a melting temperature of the solder powder, as the temperature raises, melting a resilient carrier film on which a composition is applied; once bulk melting of the carrier film has begun, a soldering flux deoxidizes and acts as a transport mechanism for a solder powder; when the melting temperature is reached, the deoxidized solder wets only the substrate metallization, and stranded solder powder is transported by a liquid flux to a desired metallization area; and cooling the tape, which Group I does not have.

The common technical features of Groups I & II are at least a method of fabricating an assembly comprising a thermal managing electrical connection tape including a carrier film and a composition having soldering flux and solder powder applied to the carrier film.

These common technical features are previously disclosed by US 2004/0026484 A1 to Yamashita, T et al. (hereinafter "Yamashita"). Yamashita discloses a method of fabricating an assembly comprising a thermal managing electrical connection tape (a method of providing a solder composition polyamide tape with electrical connections; paragraph [0046]) including a carrier film (a polyamide substrate 240; paragraph [0046]) and a composition having soldering flux and solder powder applied to the carrier film (a solder composition comprising powder and flux applied to the substrate; paragraphs [0027] & [0028]).

Since these common features are previously disclosed by Yamashita, these features are not special and therefore Group I & II lack unity.