**Title:** CONFORMAL ELECTRONICS INCLUDING NESTED SERPENTINE INTERCONNECTS

**Abstract:** An example stretchable device is described that includes electrical contacts and an interconnect coupling the electrical contacts. The interconnect has a meander-shaped configuration that includes at least one nested serpentine-shaped feature. The interconnect can be conductive or non-conductive. The meander-shaped configuration can be a serpentine structure, providing a serpentine-in-serpentine configuration.

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**Figure 1A**

- **Node 102**
- **Node 100**
- **Node 104**
Published:
— with international search report (Art. 21(3))
— 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(h))

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INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H01 R 9/00 (2014.01)
CPC - H01 L 2924/1 4 (2014.09)

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) - H01 R 9/00; H05K 1/00, 1/03 (2014.01)
USPC - 361/749, 750, 751, 776; 174/254, 255

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - H01L 2924/14, 2924/01013, 2924/01029 (2014.02) (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, ProQuest
Search term used: stretchable interconnect, serpentine, nested, elastomeric substrate

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>
</table>

Further documents are listed in the continuation of Box C.

* 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 referring 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
  *Z* document member of the same patent family

Date of the actual completion of the international search: 15 December 2014
Date of mailing of the international search report: 23 December 2014

Name and mailing address of the ISA/US
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Form PCT/ISA/2 10 (second sheet) (July 2009)
INTERNATIONAL SEARCH REPORT

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).

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

see last page

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.:

   1-13

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/2 10 (continuation of first sheet (2)) (July 2009)
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 fees must be paid.

Group I, claims 1-13, drawn to a stretchable electrical device comprising two electrical contacts

Group II, claims 14-25, drawn to a stretchable device comprising a stretchable electronic circuit

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 for the following reasons: the special technical feature of the Group I invention: "a stretchable electrical device comprising two electrical contacts and an electrical interconnect electrically coupling the two electrical contacts" as claimed therein is not present in the invention of Group II. The special technical feature of the Group II invention: "a stretchable device comprising a stretchable electronic circuit disposed on a surface of the stretchable substrate" as claimed therein is not present in the invention of Group I.

Groups I and II lack unity of invention because even though the inventions of these groups require the technical feature of the electrical interconnect having a meander-shaped configuration comprising at least one nested serpentine shaped feature, this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 2002/0094701 A1 (BIEGELSEN et al.) discloses a stretchable electrical device (a stretchable interconnect for electrically connecting electronic devices, para. 0007), comprising: two electrical contacts (electrically coupling a contact 18 of one device to a contact 18 of another device, para. 0032); and an electrical interconnect electrically coupling the two electrical contacts (the interconnect 12 for electrically coupling a contact 18 of one device to a contact 18 of another device, para. 0032); wherein the electrical interconnect has a meander-shaped configuration comprising at least one serpentine shaped feature (while V shaped section 20 are preferred other serpentine structures can be employed, para. 0071; thus figs. 3-5 show the electrical interconnect 12 has a meander-shaped configuration (winding) comprising at least one serpentine shaped feature 20).

Biegelsen et al. does not specifically teach the electrical interconnect comprising at least one nested serpentine-shaped feature. US 2007/0248799 A1 (DEANGELIS et al.) is in the field of a flexible electrical device (a flexible capacitive sensor, para. 0001) and teaches it is well known in the art that the conductive element comprising at least one nested serpentine-shaped feature (a nested serpentine configuration is used as shown in fig.4B, para. 0058; thus fig.4B shows the conductive element 230, 236 comprising at least one nested serpentine-shaped feature). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the electrical interconnect of Biegelsen et al. by including the electrical interconnect comprising at least one nested serpentine-shaped feature so as to provide the interconnect having fewer connections but greater sensitivity (DeAngelis, para. 0058).

Since none of the special technical features of the Group I or II inventions are found in more than one of the inventions, unity of invention is lacking.