ADDITIVE MANUFACTURING AND REPAIR OF METAL COMPONENTS

Abstract: Scanning Laser Epitaxy (SLE) is a layer-by-layer additive manufacturing process that allows for the fabrication of three-dimensional objects with specified microstructure through the controlled melting and re-solidification of metal powders placed atop a base substrate. SLE can be used to repair single crystal (SX) turbine airfoils, for example, as well as the manufacture of functionally graded turbine components. The SLE process is capable of creating equiaxed, directionally solidified, and SX structures. Real-time feedback control schemes based upon an offline model can be used both to create specified defect free microstructures and to improve the repeatability of the process. Control schemes can be used based upon temperature data feedback provided at high frame rate by a thermal imaging camera as well as a melt-pool viewing video microscope. A real-time control scheme can deliver the capability of creating engine ready net shape turbine components from raw powder material.
A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G05B 21/00; B23K 26/00 (2014.01)
USPC - 700/266; 219/121.6, 121.65

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): G05B 21/00; B23K 15/00, 26/00, 26/02, 26/04 (2014.01)
USPC: 700/266; 219/121.1, 121.6, 121.61,121.62, 121.64, 121.65, 121.66, 121.83

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)


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 2005/0040147 A1 (HOEBEL, M et al.) 24 February 2005, Figure 3, Abstract, Paragraphs [0035], [0040], [0041], [0044], [0046], [0049]</td>
<td>1-5</td>
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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

Date of the actual completion of the international search: 15 April 2014 (15.04.2014)

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