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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD OF MAKING HIGH-PURITY (>99%) M002 POWDERS, PRODUCTS MADE FROM M002 POWDERS, DEPOSITION OF M002 THIN FILMS, AND METHODS OF USING SUCH MATERIALS

(57) Abstract: The invention relates to high purity MoO3 powder by reduction of ammonium molybdate or molybdenum trioxide using hydrogen as the reducing agent in a rotary or boat furnace. Consolidation of the powder by press/sintering, hot pressing, and/or HIP is used to make discs, slabs, or plates, which are used as sputtering targets. The MoO3 disc, slab, or plate form is sputtered on a substrate using a suitable sputtering method or other physical means to provide a thin film having a desired film thickness. The thin films have properties such as electrical, optical, surface roughness, and uniformity comparable or superior to those of indium-tin oxide (ITO) and zinc-doped ITO in terms of transparency, conductivity, work function, uniformity, and surface roughness. The MoO3 and MoO2 containing thin films can be used in organic light-emitting diodes (OLED), liquid crystal display (LCD), plasma display panel (PDP), field emission display (FED), thin film solar cell, low resistivity ohmic contacts, and other electronic and semiconductor devices.
A. CLASSIFICATION OF SUBJECT MATTER

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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)

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

Electronic database consulted during the international search (name of database and, where practical, search terms used)

EPO-Internal, PAJ, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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Further documents are listed in the continuation of box C.

Patent family members are listed in 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 document 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
- "*" document member of the same patent family

Date of the actual completion of the international search

25 July 2005

Date of mailing of the international search report

21 October 2005

Name and mailing address of the ISA

European Patent Office, P. B. 5819 Patentlaan 2 NL - 2280 HV Rijswijk
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Authorized officer

Siebel, E
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<th>Relevant to claim No.</th>
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| X        | T. RESSLER, J. WIENOLD, R.E. JENTOFT:  
"Formation of bronzes during  
temperature-programmed reduction of MoO3  
with hydrogen - an in situ XRD and XAFS  
study"  
SOLID STATE IONICS,  
vol. 141-142, 2001, pages 243-251,  
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| A        | PATENT ABSTRACTS OF JAPAN  
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| X        | abstract | 8 |
## INTERNATIONAL SEARCH REPORT

### Box 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 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 additional 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 an additional fee, this Authority did not invite payment of any additional fee.

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.:

   1-7, 8

**Remark on Protest**

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7, 8

   A method for making high purity molybdenum (IV) oxide (MoO2) powder (Claims 1-7) and
   a molybdenum (IV) oxide (MoO2) powder comprising a greater than 99% stoichiometric amount of MoO2 (claim 8).

2. claims: 9-14, 93-94

   Method for making a plate comprising the step of isopressing
   a greater 99% stoichiometric MoO2-powder component and a plate made in accordance with said method.

3. claims: 15-27

   A method for sputtering, comprising subjecting a plate comprising 99% stoichiometric MoO2 to sputtering conditions,
   a method for producing a thin film under sputtering conditions and the obtained thin film.

4. claims: 28-35

   An organic light-emitting diode comprising a thin film comprising greater than 99% stoichiometric MoO2.

5. claims: 36-92

   An optical display device including a thin film comprising greater than 99% stoichiometric MoO2 disposed over at least a portion of a substrate.
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