

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
31 March 2011 (31.03.2011)

(10) International Publication Number  
**WO 2011/038325 A3**

PCT

(51) International Patent Classification:

**C09D 5/16** (2006.01) **C09D 201/00** (2006.01)  
**C09D 7/12** (2006.01)

(21) International Application Number:

PCT/US2010/050360

(22) International Filing Date:

27 September 2010 (27.09.2010)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/246,069 25 September 2009 (25.09.2009) US  
61/330,711 3 May 2010 (03.05.2010) US

(71) Applicant (for all designated States except US):

**HUNTER FAN COMPANY** [US/US]; 7130 Goodlett  
Farms Parkway, Suite 400, Memphis, Tennessee 38016  
(US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HAYNES, Fred**  
[US/US]; 3754 Kearney Avenue, Memphis, Tennessee  
38111 (US). **DEKROM, Adrian** [US/US]; 14722  
Munnberry Oval, Newbury, Ohio 44065-9767 (US).

(74) Agent: **MOORE, Chester, G.**; 3414 Peachtree Road,  
Suite 1600, Monarch Plaza, Atlanta, Georgia 30326-1164  
(US).

(81) Designated States (unless otherwise indicated, for every

kind of national protection available): AE, AG, AL, AM,  
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,  
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,  
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,  
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,  
KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD,  
ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,  
NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD,  
SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,  
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every

kind of regional protection available): ARIPO (BW, GH,  
GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG,  
ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ,  
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,  
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,  
LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK,  
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,  
GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(88) Date of publication of the international search report:

17 November 2011

(54) Title: DUST-REPELLENT NANOPARTICLE SURFACES

(57) Abstract: A dust-repellent composition comprising at least one hydrophobic nanoparticle is provided; surfaces having a nanoscale hydrophobic composition are also provided; and processes for making surfaces having a nanoscale hydrophobic composition are also disclosed.



WO 2011/038325 A3

**A. CLASSIFICATION OF SUBJECT MATTER***C09D 5/16(2006.01)i, C09D 7/12(2006.01)i, C09D 201/00(2006.01)i*

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)

C09D 5/16; C08K 3/36; C22C 29/12; B05D 3/02; C11D 1/82; B32B 17/06; B22F 7/00; C08K 3/22

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) &amp; Keywords: dust, repellent, hydrophobic, nanoparticle, solvent, binder, fumed, silica

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                               | Relevant to claim No. |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | P.N. MANOUDIS et al, Surface & Coating Technology, Vol. 203, Issues 10-11, Pages 1322-1328. 25 February 2009<br>See abstract and pages 1322-1323 | 1,8                   |
| Y         | -----<br>See abstract and page 1322                                                                                                              | 2-7,9-12              |
| X         | US 2008-0221009 A1 (KANAGASABAPATHY SUBBAREDDY et al.) 11 September 2008<br>See abstract and paragraphs [0082]-[0086]                            | 13,14-26              |
| Y         | -----<br>See abstract and paragraph [0082]                                                                                                       | 2-7,9-12              |
| A         | US 2009-0025508 A1 (LIAO SHIH-CHIEH et al.) 29 January 2009<br>See the whole document                                                            | 1-26                  |
| A         | US 2006-0246277 A1 (AXTELL, III et al.) 02 November 2006<br>See the whole document                                                               | 1-26                  |
| A         | US 2009-0018249 A1 (KANAGASABAPATHY SUBBAREDDY et al.) 15 January 2009<br>See the whole document                                                 | 1-26                  |



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 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

12 AUGUST 2011 (12.08.2011)

Date of mailing of the international search report

**17 AUGUST 2011 (17.08.2011)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
Government Complex-Daejeon, 189 Cheongsa-ro,  
Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

So, Jae Hyun

Telephone No. 82-42-481-8397



**INTERNATIONAL SEARCH REPORT**

International application No.

**PCT/US2010/050360****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 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.:

**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.

Group I : Claims 1-7 disclose a dust-repellent composition with a hydrophobic nanoparticle dispersed in least one solvent. And said composition is free of at least one binder. Claims 13-23 and 24-26 disclose a method of producing dust-repellent surface or a method for reducing the accumulation of dust on an object with said dust-repellent composition.

Group II : Claims 8-12 disclose a dust-repellent surface with a hydrophobic nanoparticles.

The only common technical feature between Group I and Group II is a hydrophobic nanoparticles, which creates dust-repellent surface.

However, D1, D2 or D3 discloses a surface modified nanoparticles with super-hydrophobic and self-cleaning characteristics (See pages 1322-1328 of D1, figures 1-9 and claim 1 of D2, or claims 1-15 of D3).

Therefore, these common feature lacks novelty and/or inventive step with the following document cited in this Annex:

D1: P.N. MANOUDIS et al, Fabrication of super-hydrophobic surfaces for enhanced stone protection, Surface & Coating Technology, Volume 203, Issues 10-11, 25 February 2009, Pages 1322-1328.

D2: US 2009-0025508 A1 (LIAO et al.) 2009.01.29

D3: US 2008-0221009 A1 (KANAGASABAPATHY et al.) 2008.09.11

Thus there is no technical relationship left over the prior art among the claimed inventions, leaving the claims without a single general inventive step.

Hence, there is lack of unity "a posteriori" (PCT Rules 13.1 and 13.2).

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2010/050360**

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)              | Publication<br>date      |
|-------------------------------------------|---------------------|-----------------------------------------|--------------------------|
| US 2008-0221009 A1                        | 11.09.2008          | US 2009-0018249 A1<br>WO 2007-102960 A2 | 15.01.2009<br>13.09.2007 |
| US 2009-0025508 A1                        | 29.01.2009          | DE 102007050835 A1<br>JP 2009-029690 A  | 29.01.2009<br>12.02.2009 |
| US 2006-0246277 A1                        | 02.11.2006          | US 7524531 B2                           | 28.04.2009               |
| US 2009-0018249 A1                        | 15.01.2009          | US 2008-0221009 A1<br>WO 2007-102960 A2 | 11.09.2008<br>13.09.2007 |