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(71) Applicant (for all designated States except US): YALE UNIVERSITY [US/US]; Two Whitney Avenue, New Haven, CT 06511 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): HARTWIG, John, F. [US/US]; 1407 Waverly Drive, Champaign, IL 61821 (US). SHEN, Qilong [—/US]. FERNANDEZ-RODRIGUEZ, Manuel.

(74) Agent: COLEMAN, Henry, D.; Coleman Sudol Sapone, P.C., 714 Colorado Avenue, Bridgeport, CT 06605-1601 (US).

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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: CATALYSTS FOR ARYL SULFIDE SYNTHESIS AND METHOD OF PRODUCING ARYL SULFIDES

(57) Abstract: The present invention relates to the formation of aryl sulfides and aryl thiols from aryl halides and thiols, thiolates or thiolate equivalents. The present invention provides a catalyst for the coupling of aryl halides with alkyl or aryl thiols or a hydrogen sulfide equivalent to form aryl alkyl, aryl silyl or diaryl sulfides. The reaction encompasses bromoarenes and other similar compounds containing leaving groups as well as nitrile, ester, keto, free hydroxyl, free amino, free carboxylic acid and other common functionalities. The invention can be used to prepare pharmaceutical compounds, especially including their intermediates, agricultural agents and aryl sulfide polymers.



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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 06/45973

## A. CLASSIFICATION OF SUBJECT MATTER

USPC: 548/82 ; 558/359

IPC (8): C07D 277/00 ; C07C 255/00 (2007.01)

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)

USPC--548/82 ; 558/359

IPC (8): C07D 277/00 ; C07C 255/00(2007.01)

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)

WEST (DB=PGPB,USPT,USOC,EPAB,JPAB), GOOGLE SCHOLAR/PATENTS: catalyst, halides

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	MURATA et al. A General and Efficient Method for the Palladium-Catalyzed Cross-Coupling of Thiols and Secondary Phosphines. Tetrahedron 16 July 2004, 60(34): 7397-7403; pg 7397, abstract	30-37 and 41-43
Y	ATKINSON et al. Syntheses and Catalytic Applications of Unsymmetrical Ferrocene Ligands. Chemistry Society Reviews, 19 May 2004, 33: 313-328; pg 319, Figure 18	1-3, 21-37 and 41-43
Y	US 6,124,476 A (GURAM et al) 26 September 2000 (26.09.2000); Col 27, ln 25-53; Col 28, ln 7-12; Col 11, ln 15-20	1-3, 21-37 and 41-43
Y	US 6,265,601 B1 (GURAM et al) 24 July 2001 (24.07.2001); Col 7, ln 1-10; Col 6, ln 10-13	1-3, 21-37 and 41-43

 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

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

Date of the actual completion of the international search

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Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300  
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 06/45973

**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.: 4-20, 38-40 and 44  
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:

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.:

**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.