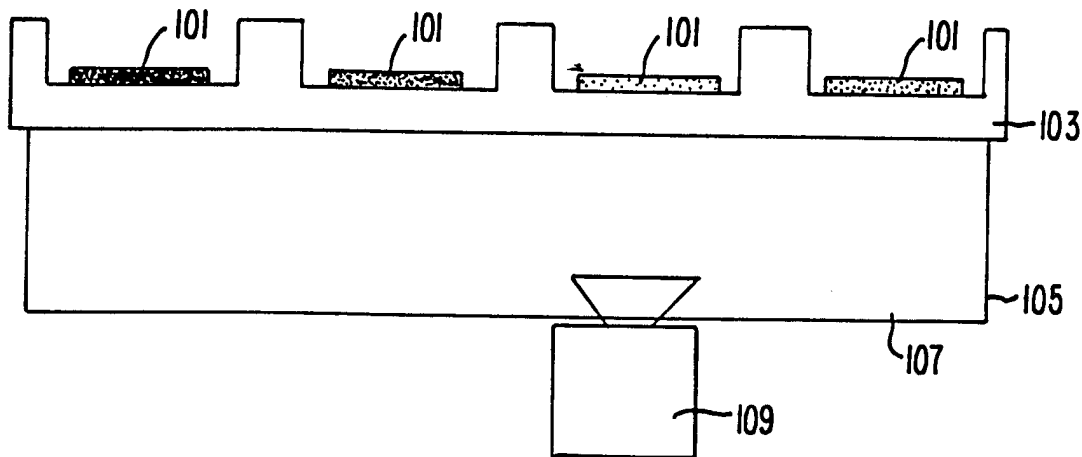




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification <sup>6</sup> : <b>G01N 29/06, 29/00, G01V 1/28, G01S 9/66</b></p>	<p><b>A3</b></p>	<p>(11) International Publication Number: <b>WO 98/15501</b> (43) International Publication Date: 16 April 1998 (16.04.98)</p>																							
<p>(21) International Application Number: PCT/US97/18192 (22) International Filing Date: 8 October 1997 (08.10.97)</p> <p>(30) Priority Data:</p> <table border="0"> <tr><td>60/028,106</td><td>9 October 1996 (09.10.96)</td><td>US</td></tr> <tr><td>60/028,105</td><td>9 October 1996 (09.10.96)</td><td>US</td></tr> <tr><td>60/029,255</td><td>25 October 1996 (25.10.96)</td><td>US</td></tr> <tr><td>60/035,202</td><td>10 January 1997 (10.01.97)</td><td>US</td></tr> <tr><td>60/035,366</td><td>10 January 1997 (10.01.97)</td><td>US</td></tr> <tr><td>60/048,987</td><td>9 June 1997 (09.06.97)</td><td>US</td></tr> <tr><td>60/050,949</td><td>13 June 1997 (13.06.97)</td><td>US</td></tr> <tr><td>08/898,715</td><td>22 July 1997 (22.07.97)</td><td>US</td></tr> </table> <p>(71) Applicant: SYMYX TECHNOLOGIES [US/US]; 3100 Central Expressway, Santa Clara, CA 95051 (US). (72) Inventors: MCFARLAND, Eric; 607 North 3rd Street, San Jose, CA 95112 (US). MATSIEV, Leonid; 10350 Leola Court #1, Cupertino, CA 95014 (US). (74) Agents: BECK, David, G. et al.; Townsend and Townsend and Crew LLP, 8th floor, Two Embarcadero Center, San Francisco, CA 94111 (US).</p>	60/028,106	9 October 1996 (09.10.96)	US	60/028,105	9 October 1996 (09.10.96)	US	60/029,255	25 October 1996 (25.10.96)	US	60/035,202	10 January 1997 (10.01.97)	US	60/035,366	10 January 1997 (10.01.97)	US	60/048,987	9 June 1997 (09.06.97)	US	60/050,949	13 June 1997 (13.06.97)	US	08/898,715	22 July 1997 (22.07.97)	US	<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p> <p>(88) Date of publication of the international search report: 25 June 1998 (25.06.98)</p>
60/028,106	9 October 1996 (09.10.96)	US																							
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08/898,715	22 July 1997 (22.07.97)	US																							

(54) Title: SYSTEMS AND METHODS FOR CHARACTERIZATION OF MATERIALS AND COMBINATORIAL LIBRARIES WITH MECHANICAL OSCILLATORS



(57) Abstract

Methods and apparatus for screening diverse arrays of materials and for imaging a library of materials are provided using ultrasonic imaging techniques. Systems include transducer lens (109) or mechanical resonator for exciting an element of library deposited onto a substrate (103) such that acoustic waves are propagated through, and from, the library element (101). The acoustic waves propagated from the element are detected and processed to yield a visual image of the library element; such acoustic wave data is processed to obtain information about various properties of the library elements (e.g. elasticity, molecular weight, viscosity, specific weight, dielectric properties, conductivity, etc.) of individual liquid elements. Acoustic waves are generated in an imaging tank filled with coupling liquid (107), with the library of materials then placed in the tank while the surface of the coupling liquid is scanned with a laser beam. The physical structure of the liquid surface disturbed by these acoustic waves is recorded.

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DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/18192

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : G01N 29/06, 29/00; G01V 01/28; G01S 09/66  
US CL : Please See Extra Sheet.

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)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
**none**

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
Please See Extra Sheet.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3,778,757 A (HOUSTON) 11 December 1973 (11.12.73) Figures 8, 9, 11 plus col. 2, line 31-col. 3, line 35 and col. 6, lines 3-51.	1, 4, 14, 20, 15, 17, 27, 42, 43, 45, 19, 47, 48
A	US 3,622,968 A (SILVERMAN) 23 November 1971 (23.11.71)	1, 4, 14-17, 27, 42-45, 48, 20, 19 and 47
A	US 5,469,369 A (ROSE-PEHRSSON et al.) 21 November 1995 (21.11.95)	1, 4, 14-17, 27, 42-45, 20, 48, 19 and 47

Further documents are listed in the continuation of Box C.       See patent family annex.

<p>* Special categories of cited documents:</p> <p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document published on or after the international filing date</p> <p>*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)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p>	<p>*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</p> <p>*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</p> <p>*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</p> <p>* &amp; * document member of the same patent family</p>
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Date of the actual completion of the international search

16 MARCH 1998

Date of mailing of the international search report

27 APR 1998

Name and mailing address of the ISA/US  
Commissioner of Patents and Trademarks  
Box PCT  
Washington, D.C. 20231

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Authorized officer

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/18192

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,375,470 A (MATSUSHIMA et al.) 27 December 1994 (27.12.94)	1,4,14-17, 27,42-45, 19,47, 20 and 48
Y	US 4,910,523 A (HUGUENIN et al.) 20 March 1990 (20.03.90) Figures 3-4, 6-7 and 9 plus col. 11, lines 19-63, col. 12, lines 20-59 and col.3, lines 38-60.	1,4,14-18, 27,42-47, 19, 48 and 20
X	US 5,357,964 A (SPIVEY et al.) 25 October 1994 (25.10.94) Figures 1, 3, 5-6 and 8 plus col. 1, lines 24-68, col. 3, lines 6-39 and col. 9, lines 27-66.	1,4,14-20, 27 & 43-48
A	US 3,718,032 A (GRAY) 27 February 1973 (27.02.73) figures 2-3 and col. 3, line 18 - col. 4, line 22.	1, 4,14-17, 27, 43-45, 19, 47,48 and 20
A	US 5,191,791 A (GERARDI et al.) 09 March 1993 (09.03.93) Figures 1, 8, 11, 12, 15 and 17.	1,4, 14-17, 27, 43-45, 19, 47-48 and 20
A	US 4,370,662 A (HOU et al.) 25 January 1983 (25.01.83) col. 4, lines 13-62 and col.3, lines 31-51 plus Figure 5.	1,4,14-17, 27,42-45, 19, 47, 48 and 20
A	US 5,224,174 A SCHNEIDER et al.) 29 June 1993 (29.06.93)	1,4, 14-17, 27, 42-45, 19, 47, 48 and 20
Y	US 4,779,451 A (EZAWA et al.) 25 October 1988 (25.10.88) Figures 1, 5 and 2c plus col. 2, lines 2-32 and col. 4, lines 21-45.	1,4, 14-19 27, 43-48 and 20
Y	US 5,524,636 A (SARVAZYAN et al.) 11 June 1996 (11.06.96) figures 13a, 13b, 18, 19, 23-26, 27 & 30, col. 1, lines 26-55, col. 2, lines 1-45, col. 21, lines 16-53 and col. 22, lines 9-63.	1,4, 14-20, 27 and 42-48

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/18192

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international 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 II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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

Please 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.  
 No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/18192

## A. CLASSIFICATION OF SUBJECT MATTER:

US CL :

073/53.01, 54.01, 61.45, 54.41, 579, 592, 626; 324/204, 453, 636

## B. FIELDS SEARCHED

Minimum documentation searched

Classification System: U.S.

073/53.01, 54.01, 54.02, 61.45, 61.49, 54.41, 64.53, 64.54, 579, 592, 626; 324/204, 453, 636, 640, 80, 71.1;128/661.01,660.07;340/621

## B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

APS search terms: array, well, acoustic resonator, vibration oscillator, sonic stimulus, liquid, combinatorial library, frequency spectrum, time response, amplitude attenuation or damping, material properties, imaging tank, modal resonance, echo, reflected wave, coupling medium, sensor, transducer or detector, catalyst reaction, tuning fork, scattered wave, piezoelectric

## BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I, claims 1-13, 15-16, 27-41, and 43-44, drawn to a method or system for determining a specific characteristic(s) of each liquid material within an array of liquid materials by means of measurements made for *frequency response* resulting from a known stimulus applied to an array of resonators; i.e.- amplitude versus frequency.

Group II, claims 14, 17, 42 and 45, drawn to a method or system for determining a specific characteristic(s) of each liquid material within an array of liquid materials by means of measurements made for *temporal response* resulting from a known stimulus applied to an array of resonators; i.e.- amplitude versus time.

Group III, claims 18 and 46, drawn to a method or system for imaging a combinatorial array of materials by generating an acoustic field within an imaging tank filled with coupling fluid and a combinatorial array of materials, and scanning a surface of coupling fluid with a laser beam, and detecting the *laser beam scattered* from such surface; so as determine a characteristic(s) of materials within an array of materials.

Group IV, claims 19 and 47, drawn to a method or system for imaging a combinatorial array of materials by generating an acoustic field within an imaging tank filled with coupling fluid and a combinatorial array of materials, and detecting the *received reflections* of same *acoustic field* from such combinatorial array of materials; so as determine a characteristic(s) of materials within the combinatorial array of materials.

Group V, claims 48-53 and 20-26, drawn to a method or system for imaging a combinatorial array of materials, and monitoring the *received echoes* produced by an interaction of such acoustic energy with each material in same array of materials, a receiver and processor for calculating a magnitude of such echoes and the time delay between application of acoustic energy and receipt of such resulting echoes; so that processor can determine *an image* of such materials from same magnitude and time delay information.

The inventions listed as Groups I-V do not relate to a single 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: In regards to Groups I and II, the basic operating principles and equipments are considered different for two methods that determine some properties of a combinatorial array of liquid materials by means of 1) frequency response measurements; and 2) amplitude versus time, Q-factor or resonance response measurements [but no definite imaging or physical structure determination is performed as in Groups III, IV and V]. In regards to both Groups III and IV an acoustic field is generated within an imaging tank- determination of physical structure is performed so as to yield an imaging of a combinatorial array of materials, but Group III scans with a laser beam and detects scattered light from the surface of coupling fluid with array of materials therein, while Group IV detects received reflections of acoustic field from such array of materials [no laser beam used, and no interaction of acoustic energy defined]. Finally, Group V has a receiver to monitor the echoes produced by interaction of acoustic energy with each material in such array of materials, while a processor calculates echo magnitude and echo time delay so as to yield an imaging of same array of materials [no laser

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/18192

beam used, no scattered light , no frequency response, no resonance response; but also the noted calculations go beyond the mere detection of reflected acoustic energy of the Group IV invention].