



US006928877B2

(12) **United States Patent**  
**Carlson et al.**

(10) **Patent No.:** **US 6,928,877 B2**  
(45) **Date of Patent:** **Aug. 16, 2005**

(54) **HIGH THROUGHPUT MICROBALANCE AND METHODS OF USING SAME**

5,235,844 A \* 8/1993 Bonne et al. .... 73/24.01

(Continued)

(75) Inventors: **Eric D. Carlson**, Cupertino, CA (US);  
**Oleg Kolosov**, San Jose, CA (US);  
**Leonid Matsiev**, San Jose, CA (US);  
**Laura T. Mazzola**, Redwood City, CA (US);  
**Mikhail Spitkovsky**, Sunnyvale, CA (US);  
**John Gallipeo**, Morgan Hill, CA (US)

**FOREIGN PATENT DOCUMENTS**

EP	0779510 A2	6/1997	
GB	1 385 488	* 2/1975	..... F27B/17/02
JP	02161323 A	* 6/1990	..... G01G/3/16
WO	WO 99/18431	4/1999	
WO	WO 00/58709 A	* 10/2000	..... G01N/5/00
WO	WO 00/67086	11/2000	
WO	WO 01/77624	10/2001	
WO	WO 02/12265	2/2002	
WO	PCT/US02/16962	5/2002	
WO	WO 03/014732	2/2003	

(73) Assignee: **Symyx Technologies, Inc.**, Santa Clara, CA (US)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

**OTHER PUBLICATIONS**

Smith, Allan L. et al., "Water sorption isotherms and enthalpies of water sorption by lysozyme using the quartz crystal microbalance/heat conduction calorimeter," *Biochimica Et Biophysica Acta* 1594 (2002), pp. 150-159.

PCT Invitation to Pay Additional Fees with attached Annex to Form PCT/ISA/206—Communication Relating to the Results of the Partial International Search dated Sep. 2, 2003 (PCT/US03/12503) (1012-171WO).

(21) Appl. No.: **10/155,207**

(22) Filed: **May 24, 2002**

(65) **Prior Publication Data**

US 2003/0218467 A1 Nov. 27, 2003

(51) **Int. Cl.**<sup>7</sup> ..... **G01N 29/16**

(52) **U.S. Cl.** ..... **73/579; 73/32 A; 73/865.6; 73/866**

(58) **Field of Search** ..... **73/24.05-24.06, 73/30.04, 31.06, 32 A, 54.26, 54.41, 61.49, 61.75, 61.79, 579, 29.01, 73, 865.6, 866**

(Continued)

*Primary Examiner*—Hezron Williams

*Assistant Examiner*—Rose M. Miller

(74) *Attorney, Agent, or Firm*—Dobrusin & Thennisch PC

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

3,926,271 A	* 12/1975	Patashnick	..... 177/210 R
4,103,224 A	7/1978	Taro et al.	
4,391,338 A	* 7/1983	Patashnick et al.	.... 177/210 FP
4,535,620 A	8/1985	Cunningham	
4,624,129 A	* 11/1986	Haynes	..... 73/32 A
4,696,181 A	* 9/1987	Rupprecht et al.	..... 73/580
5,201,215 A	* 4/1993	Granstaff et al.	..... 73/54.41

(57) **ABSTRACT**

A method and apparatus for measurement of mass of small sample sizes. The method and apparatus is particularly adapted for providing microbalance measurement of solid materials as part of a combinatorial research program. The method and apparatus contemplate monitoring the response of a resonator holding a sample and correlating the response with mass change in the samples.

**11 Claims, 9 Drawing Sheets**

