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(54) **SILICON MICROMACHINED ULTRA-SENSITIVE VIBRATION SPECTRUM SENSOR ARRAY (VSSA)**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,745,384	A	7/1973	Blanchard	
4,344,328	A	8/1982	Hawkins	
5,001,933	A	3/1991	Brand	
5,089,695	A	2/1992	Willson et al.	
5,610,337	A	3/1997	Nelson	
5,856,722	A	1/1999	Haronian et al.	
6,079,274	A *	6/2000	Ando et al.	73/649
6,223,601	B1 *	5/2001	Harada et al.	73/649
6,327,909	B1 *	12/2001	Hung et al.	73/514.16
6,374,677	B1	4/2002	Berlin et al.	
6,402,968	B1 *	6/2002	Yazdi et al.	216/2
6,408,496	B1	6/2002	Maynard	
6,438,243	B1	8/2002	Ikeuchi et al.	
6,484,109	B1 *	11/2002	Lofall	702/56
6,622,647	B2	9/2003	DePoy	
7,092,539	B2 *	8/2006	Sheplak et al.	381/114
2003/0005872	A1 *	1/2003	DePoy, II	114/21.3

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0 959 333 A2 11/1999

OTHER PUBLICATIONS

PCT/US2006/012602, Aug. 31, 2006, International Search Report.

(Continued)

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(57) **ABSTRACT**

An apparatus comprising a substrate and an array of vibration sensors formed on the substrate, the array comprising two or more vibration sensors, wherein each vibration sensor in the array has a different noise floor and a different operational frequency range than any of the other vibration sensors in the array. A process comprising forming an array of vibration sensors on a substrate, the array comprising two or more vibration sensors, wherein each of the two or more vibration sensors in the array has a different noise floor and a different operational frequency range than any of the other vibration sensors in the array. Other embodiments are disclosed and claimed.

25 Claims, 6 Drawing Sheets