



US007284442B2

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

(10) **Patent No.:** **US 7,284,442 B2**
(45) **Date of Patent:** **Oct. 23, 2007**

(54) **METHOD AND APPARATUS FOR IN VIVO SENSING**

(75) Inventors: **Aaron J. Fleischman**, University Heights, OH (US); **James R. Talman**, Crofton, MD (US); **Shuvo Roy**, Shaker Heights, OH (US)

(73) Assignee: **The Cleveland Clinic Foundation**, Cleveland, OH (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.

(21) Appl. No.: **11/441,855**

(22) Filed: **May 26, 2006**

(65) **Prior Publication Data**
US 2007/0049845 A1 Mar. 1, 2007

Related U.S. Application Data
(60) Provisional application No. 60/685,729, filed on May 27, 2005.

(51) **Int. Cl.**
A61B 5/05 (2006.01)
(52) **U.S. Cl.** **73/753; 600/345**
(58) **Field of Classification Search** **73/700, 73/753, 754; 600/345**
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
4,114,601 A 9/1978 Abels

5,626,630 A	5/1997	Markowitz et al.
5,967,986 A	10/1999	Cimochowski et al.
6,682,480 B1	1/2004	Habib et al.
2004/0133131 A1*	7/2004	Kuhn et al. 600/593
2005/0165317 A1	7/2005	Turner et al.
2006/0074479 A1*	4/2006	Bailey et al. 623/1.13

FOREIGN PATENT DOCUMENTS

WO	WO 2000/013585 A2	3/2000
WO	WO 2005/027998 A2	3/2005

* cited by examiner

Primary Examiner—Andre J Allen
(74) *Attorney, Agent, or Firm*—Tarolli, Sundheim, Covell & Tummino LLP

(57) **ABSTRACT**

Systems and methods for in vivo sensing are provided. An excitation signal is produced, having a first frequency component and a second frequency component. The first frequency component is swept through a plurality of excitation frequencies within a frequency range of interest. A response signal is received from an in vivo sensor. The response signal includes a mix component having a frequency equal to one of a sum of a first excitation frequency associated with the first frequency component and a second excitation frequency associated with the second frequency component and a difference between the first and second excitation frequencies. The mix component is evaluated to determine a resonant frequency of the in vivo sensor.

20 Claims, 5 Drawing Sheets

