US 20100024879A1

(19) United States

(12) Patent Application Publication

Richter et al.

(10) Pub. No.: US 2010/0024879 A1

(43) Pub. Date: Feb. 4, 2010

(54) TITANIA NANOTUBES PREPARED BY ANODIZATION IN CHLORIDE-CONTAINING ELECTROLYTES

(75) Inventors: **Christiaan Richter**, Boston, MA (US); **Latika Menon**, Boston, MA (US); **Ronald J. Willey**, Dedham, MA (US)

Correspondence Address:
WEINGARTEN, SCHURGIN, GAGNEBIN & LEBOVICI LLP
TEN POST OFFICE SQUARE
BOSTON, MA 02109 (US)

(73) Assignee: **NORTHEASTERN UNIVERSITY**, Boston, MA (US)

(21) Appl. No.: **12/527,889**

(22) PCT Filed: **Feb. 21, 2008**

(86) PCT No.: **PCT/US08/02282**

§ 371 (c)(1), (2), (4) Date: **Aug. 20, 2009**

Related U.S. Application Data

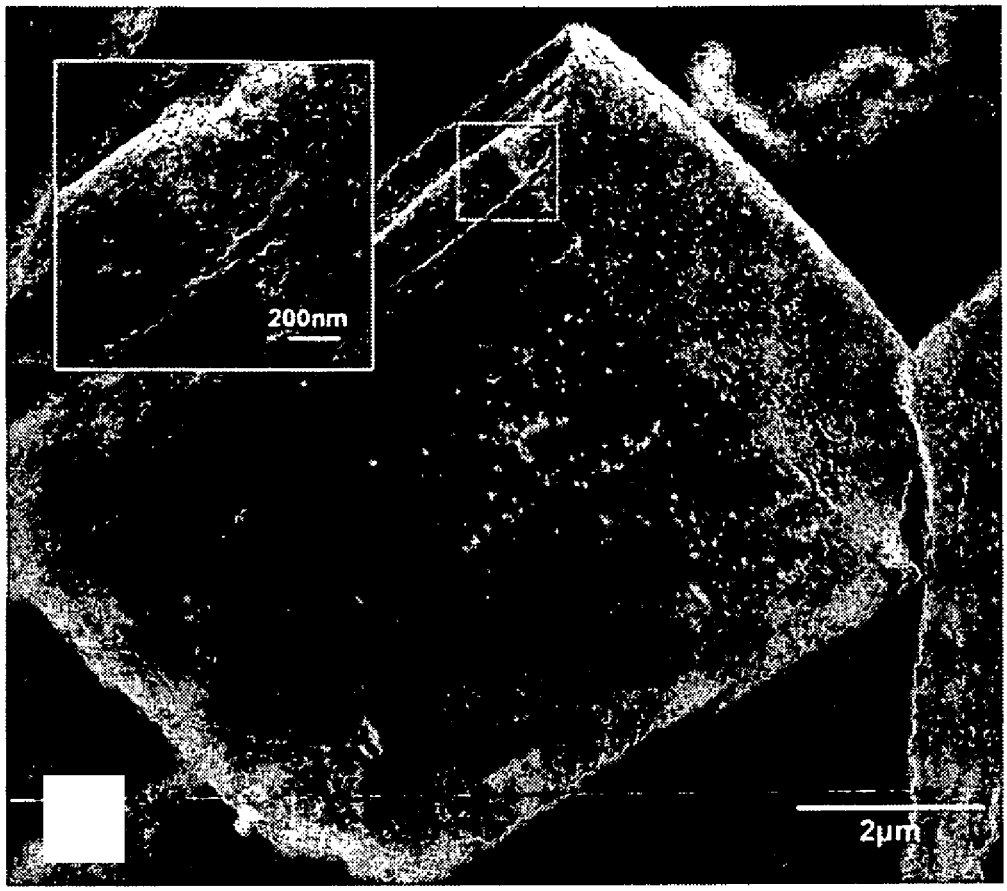
(60) Provisional application No. 60/902,448, filed on Feb. 21, 2007.

Publication Classification

(51) **Int. Cl.**

H01L 31/00	(2006.01)
C25D 1/00	(2006.01)
C01G 23/047	(2006.01)
C25D 17/00	(2006.01)

(52) **U.S. Cl.** **136/256**; 205/74; 205/50; 204/242; 977/899; 977/811; 977/776; 977/762

(57) **ABSTRACT**

A method of preparing titania nanotubes involves anodization of titanium in the presence of chloride ions and at low pH (1-7) in the absence of fluoride. The method leads to rapid production of titania nanotubes of about 25 nm diameter and high aspect ratio. The nanotubes can be organized into bundles and tightly packed parallel arrays. Inclusion of organic acids in the electrolyte solution leads to the incorporation into the nanotubes of up to 50 atom percent of carbon. In a two-stage method, a titanium anode is pre-patterned using a fluoride ion containing electrolyte and subsequently anodized in a chloride ion containing electrolyte to provide more evenly distributed nanotube arrays. The titania nanotubes have uses in composite materials, solar cells, hydrogen production, and as hydrogen sensors.