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(54) **STRONTIUM PHOSPHATE MICROPARTICLE FOR RADIOLOGICAL IMAGING AND THERAPY**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,331,784	A	7/1967	Meyer et al.	
3,851,044	A	11/1974	Adler et al.	
4,339,421	A	7/1982	Schultess et al.	
4,789,501	A	12/1988	Day et al.	
5,011,677	A	4/1991	Day et al.	
5,011,797	A	4/1991	Day et al.	
5,302,369	A	4/1994	Day et al.	
5,560,901	A	10/1996	Brodack et al.	
5,611,833	A	3/1997	Brahmbhatt et al.	
5,651,956	A	7/1997	Nosco et al.	
5,690,908	A	11/1997	Deutsch et al.	
6,165,440	A	12/2000	Esenaliev	
6,358,531	B1 *	3/2002	Day et al.	424/489
6,379,648	B1	4/2002	Day et al.	
6,455,024	B1	9/2002	Glajch et al.	
6,537,518	B1	3/2003	Gray	
6,589,549	B2	7/2003	Shih et al.	
6,797,704	B2	9/2004	Leong et al.	
7,534,448	B2	5/2009	Saltzman et al.	
7,768,399	B2	8/2010	Hachmann et al.	
7,959,900	B2 *	6/2011	Peng et al.	424/1.11
8,865,123	B1 *	10/2014	Day et al.	424/1.61
2004/0197264	A1	10/2004	Schwarz et al.	
2004/0258614	A1	12/2004	Line et al.	
2007/0053830	A1	3/2007	Peng et al.	
2008/0038190	A1	2/2008	Simpson et al.	
2008/0226547	A1	9/2008	Larsen et al.	
2009/0208428	A1	8/2009	Hill et al.	
2010/0055019	A1	3/2010	Day et al.	
2010/0160527	A1	6/2010	Royer et al.	

FOREIGN PATENT DOCUMENTS

CN	1127093	A	12/1999
CN	1640498	A	7/2005
CN	101284161	A	10/2008
CN	101321542	A	12/2008
EP	1162626	A1	12/2001
WO	0029034		5/2000
WO	2005087274		9/2005
WO	2005/993673	A2	10/2005
WO	2009/064460	A2	5/2009

OTHER PUBLICATIONS

Conzone, S. et al., Journal of Biomedical Materials Research, Part A (2008), 88A, (2), 531-542.*

International Search Report, PCT/US2014/061597, dated Jun. 25, 2015, 5 pages.

Written Opinion, PCT/US2014/061597, dated Jun. 25, 2015, 6 pages.

Sinouh et al., "Effect of TiO2 and SrO additions on some physical properties of 33Na2O-xSrO-xTiO2-(50-2x)B2O3-17P2O5 glasses", Journal of Thermal Analysis and Calorimetry, 2013, vol. 111, No. 1, pp. 401-408.

Yao, et al., "In vitro Bioactive Characteristics of Borate-based Glasses with Controllable Degredation Behavior," 2007, Journal of the American Ceramic Society.

Cast Steel: Gas Nitriding, Keyto Metals, 2009-2010. (not attributed).

Turker and Ozer, Diagnotic Radiopharmaceutical Agents, Journal of Pharmaceutical Science, 29, 145-154, 2004.

Karesh, et al., Radiopharmaceuticals in Nuclear Medicine, nucmedtutorials.com, Apr. 8, 2010.

Saatchi and Hafeli, Radiolabeling of Biodegradable Polymeric Microspheres with [99mTc(C0)3]+ and in Vivo Biodistribution Evaluation using MicroSPECT/CT Imaging, Bioconjugate Chem., 2009, 20, 1209-1217.

Christoffersen, et al., "Effects of Strontium Ions on Growth and Dissolution of Hydroxyapatite and on Bone Mineral Detection," Bone, Official Journal of the International Bone and Mineral Society, vol. 20, Issue 1, pp. 47-54, Jan. 1997.

(Continued)

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(57) **ABSTRACT**

This invention relates to a method for making strontium-phosphate microparticles that incorporate radioisotopes for radiation therapy and imaging.

17 Claims, No Drawings