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[Continued on next page]

(54) Title: METHODS AND SYSTEMS FOR OPTICALLY CHARACTERIZING A TURBID MATERIAL USING A STRUCTURED INCIDENT BEAM

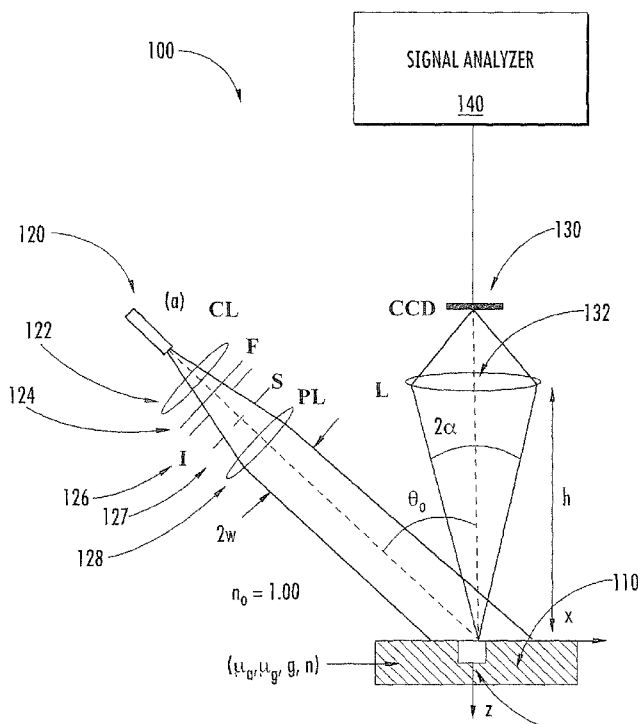


FIG. 1A

(57) Abstract: Methods and systems for optically characterizing a turbid sample are provided. A structured light beam is impinged on the sample. The sample includes an embedded region. A reflected light image of the structured light beam is detected from the sample. A measured reflectance image of the structured light beam for the sample is determined based on the reflected light image and a reflectance standard. The following parameters are determined: absorption coefficients  $\bar{\gamma}_a$ , scattering coefficient  $\bar{\gamma}_s$  and anisotropy factor  $g$  of the sample from the reflectance image. A size parameter of the embedded region is estimated based on the absorption coefficients  $\bar{\gamma}_a$ , scattering coefficient  $\bar{\gamma}_s$  and/or anisotropy factor  $g$  of the sample from the measured reflectance image.



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**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) &amp; Keywords turbid ,tissue, light, embedded, laser and similar terms

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	CHEN, C. et al. Med. Phys. 2007, Vol 34, No.7, pp. 2939-2948, 31 July 2007 See abstract and chapters 1, 2	1,2,4-6,9-12,13 ,15-17,20-22,23
A	CHEN, C. et al. Optics Express. 2006, Vol.14, No.16, pp 7420-7435, 07 August 2006 See abstract and chapters 1-3	1-23
A	EP 1707944 A2 (XENOGEN CORPORATION) 04 October 2006 See paragraphs 27-42, 63-70 and figures 1-3	1-23
A	US 5416582 A (KNUTSON, J. R. et al.) 16 May 1995 See abstract, column 7, line 55 - column 8, line 45 and figures 1-5	1-23
A	US 5929443 A (ALFANO, R. R. et al.) 27 July 1999 See abstract, column 14 and figures 2-4, 9-11	1-23

 Further documents are listed in the continuation of Box C See patent family annex

\* Special categories of cited documents

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1707944 A2	04.10.2006	AU 2002-303819 B2	01.03.2007
		CA 2447262-A1	21.11.2002
		EP 1402243 A2	31.03.2004
		EP 1402243 B1	16.08.2006
		EP 1707944 A3	08.11.2006
		JP 04259879 B2	30.04.2009
		JP 2004-528916 A	24.09.2004
		KR 10-2004-0012844 A	11.02.2004
		WO 02-093143 A2	21.11.2002
		WO 02-093143 A3	21.11.2002
		US 5416582 A	16.05.1995
US 5929443 A	27.07.1999	US 5719399 A	17.02.1998
		US 5847394 A	08.12.1998
		WO 97-22871 A1	26.06.1997