US007629569B2

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

(10) **Patent No.: US 7,629,569 B2**
(45) **Date of Patent: Dec. 8, 2009**

(54) **ELLIPTICAL POLARIZERS, TAGS AND IDENTIFICATION SYSTEMS USING FREQUENCY SELECTIVE SURFACES**

(75) Inventors: **Jeff Tharp**, Pittsburgh, PA (US); **Glenn Boreman**, Geneva, FL (US); **Daniel E. Mullally**, Winter Park, FL (US)

(73) Assignee: **University of Central Florida Research Foundation, Inc.**, Orlando, FL (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.: **12/128,431**

(22) Filed: **May 28, 2008**

(65) **Prior Publication Data**

US 2009/0121014 A1 May 14, 2009

Related U.S. Application Data

(60) Provisional application No. 60/986,484, filed on Nov. 8, 2007.

(51) **Int. Cl.**
G02F 1/01 (2006.01)

(52) **U.S. Cl.** **250/225**; 250/227.17; 359/486

(58) **Field of Classification Search** 250/225, 250/216, 227.11, 227.17; 359/486, 494, 359/495, 566, 569, 571, 572, 573, 574, 576
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2003/0214456 A1 * 11/2003 Lynch et al. 343/909
2005/0045799 A1 * 3/2005 Deng et al. 250/200
2006/0227422 A1 * 10/2006 Monacelli et al. 359/485

* cited by examiner

Primary Examiner—Thanh X Luu
Assistant Examiner—Francis M Legasse, Jr.
(74) *Attorney, Agent, or Firm*—Patents On Demand, P.A.; Neil R. Jetter

(57) **ABSTRACT**

An optical combination includes a substrate, a linear polarizer on the substrate, and a first frequency selective surface (FSS) based elliptical polarization filter on the linear polarizer. The first FSS comprises at least one periodic pattern of spaced apart electrically conductive lines having a sub-wavelength line-to-line spacing orientated along a first axis. The pattern is operable to impose a phase differential for one orthogonal linear polarization state relative to the other linear polarization state for electromagnetic radiation having a wavelength between 400 nm and 1 mm, such as 1 μm to 12 μm. An identification system and associated method for identifying objects includes at least one tag having encoded information attached to the surface of an object to be identified, wherein the tag includes a first FSS-based elliptical polarization filter which provides the encoding. A remotely located receiver including a second FSS-based elliptical polarization filter and a linear polarizer optically coupled to the second filter is operable for differentially attenuating the first and second orthogonal polarization states allowing a determination whether the intensity pattern corresponds to the encoded information.

14 Claims, 11 Drawing Sheets