IMAGING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation application of U.S. patent application Ser. No. 14/035,377 filed on Sep. 24, 2013. This application claims priority to Japanese Patent Application No. 2012-211940 filed on Sep. 26, 2012. The entire disclosures of U.S. patent application Ser. No. 14/035,377 and Japanese Patent Application No. 2012-211940 are hereby incorporated herein by reference.

BACKGROUND

Technical Field

The present invention relates to an imaging apparatus which images a subject.

Background Technology

In the past, various technologies have been proposed where an image of veins in a living body is imaged for biometric authentication. For example, Patent Document 1 discloses a finger authentication apparatus where a light source section and an imaging section are arranged so as to face each other interposing a subject (a finger of the person to be authenticated) and light which has been emitted from the light source section and passed through a subject is imaged by the imaging section.

There is a problem in the technology of Patent Document 1 in that it is difficult to reduce the size of the apparatus since it is necessary to arrange the light source section and the imaging section so as to face each other interposing a subject. From the point of view of solving the problem described above, for example, Patent Document 2 discloses an imaging apparatus with a structure where a light source layer and a detection layer are laminated on a surface of a substrate. Light which has been emitted from the light source layer and passed through a subject is detected by each light receiving element in the detection layer. A light blocking layer which prevents direct irradiation from the light source layer with regard to the detection layer is arranged between the light source layer and the detection layer.

Japanese Laid-open Patent Publication No. 2003-30632 (Patent Document 1) and Japanese Laid-open Patent Publication No. 2009-3821 (Patent Document 2) are examples of the related art.

SUMMARY

However, there is a problem in the technology in Patent Document 2 in that it is difficult to maintain a sufficient amount of light which is incident from the subject to each light receiving element. Considering the situation described above, the invention has the advantage of maintaining a sufficient amount of light which reaches from a subject to light receiving elements.

In order to solve the problem described above, an imaging apparatus of the invention is provided with an optically transmissive first substrate (for example a substrate **32**) which includes a first surface (for example, a surface **321**), a plurality of lenses which oppose the first surface and focus incident light from the opposite side to the first substrate, a light emitting layer on a surface of the first surface, and a plurality of light receiving elements which are arranged on the opposite side to the plurality of lenses so as to interpose the first substrate. It is possible to maintain a sufficient amount of light which reaches from a subject to the light receiving elements compared with the technique in Patent Document 2 where there is no lens which focuses incident light from the subject since incident light from the subject which has been illuminated by light emitted from the light emitting layer reaches each of the light receiving elements after being focused by the plurality of lenses. Here, the "plurality of lenses" in the invention are a portion or all of the lenses which are provided in the imaging apparatus (for example, lenses other than dummy lenses which do not contribute to light focusing). In a similar manner, the "plurality of light receiving elements" in the invention are a portion or all of the light receiving elements which are provided in the imaging apparatus (for example, light receiving elements other than dummy light receiving elements which do not contribute to imaging).

An imaging apparatus according to one aspect includes a light emitting element layer, an optically transmissive first substrate and a light receiving element. The light emitting element layer faces a plurality of lenses. The optically transmissive first substrate includes a first surface with the light emitting element layer being disposed on the first surface. The light receiving element is arranged on an opposite side to the light emitting element layer so as to interpose the first substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the attached drawings which form a part of this original disclosure:

FIG. **1** is a cross sectional diagram of an imaging apparatus according to a first embodiment of the invention;

FIG. **2** is an exploded cross sectional diagram of the imaging apparatus;

FIG. **3** is a planar diagram illustrating a relationship between each element of the imaging apparatus;

FIG. **4** is a cross sectional diagram where a light emitting element layer is enlarged;

FIG. **5** is a planar diagram illustrating a relationship between an insulating layer and a light emitting region;

FIG. **6** is an explanatory diagram of a first straight line and a second straight line in a second embodiment;

FIG. **7** is a cross sectional diagram of a light emitting layer in the second embodiment;

FIG. **8** is a planar diagram illustrating a relationship between an insulating layer and a light emitting region in the second embodiment;

FIG. **9** is an explanatory diagram of a third straight line and a fourth straight line in a third embodiment; and

FIG. **10** is a cross sectional diagram of a light emitting element layer in the third embodiment.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

First Embodiment

FIG. **1** is a cross sectional diagram of an imaging apparatus **100** according to a first embodiment of the invention. FIG. **2** is an exploded cross sectional diagram of the imaging apparatus **100**. The imaging apparatus **100** of the first embodiment is a sensing apparatus which images a subject **200** in a state in which illumination light with a specific wavelength (referred to below as "imaging light") is irradiated, and for example, is preferably used as a biometric authentication apparatus (vein sensor) which images an image of veins in a living body (typically, a human finger). The imaging light is, for example, near infrared light. As