United States Patent	12389570
Kind Code	B2
Date of Patent	August 12, 2025
Inventor(s)	Lin; Tzu-Yuan et al.

Electronic device

Abstract

The present disclosure discloses an electronic device which includes an electronic panel and a supporting plate. The electronic panel includes a substrate, an electronic component disposed on the first surface of the substrate, and a circuit board disposed on the second surface of the substrate. The first surface is opposite to the second surface, and the electronic component and the circuit board are electrically connected to each other. The supporting plate is arranged under the electronic panel and includes an opening through which the circuit board passes. The difference of the thermal expansion coefficient between the substrate and the supporting plate is less than or equal to 4 ppm/° K.

Inventors: **Lin; Tzu-Yuan (Miao-Li County, TW), Hsieh; Tsau-Hua (Miao-Li County, TW), Shih; Jian-Jung (Miao-Li County, TW)**

Applicant: **InnoLux Corporation** (Miao-Li County, TW)

Family ID: **1000008751421**

Assignee: **InnoLux Corporation (Miao-Li County, TW)**

Appl. No.: **18/134584**

Filed: **April 14, 2023**

Prior Publication Data

Document Identifier	Publication Date
US 20230371205 A1	Nov. 16, 2023

Foreign Application Priority Data

CN	202210533746.3	May. 16, 2022

Publication Classification

Int. Cl.: **H05K7/20** (20060101); **H05K5/02** (20060101); **H05K5/30** (20250101)

U.S. Cl.:

CPC **H05K7/2039** (20130101); **H05K5/0221** (20130101); **H05K5/30** (20250101); **H05K7/20963** (20130101);

Field of Classification Search

CPC: H05K (7/2039); H05K (7/20963); H05K (5/0221); H05K (5/30)

USPC: 361/707

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
7053314	12/2005	Camerlo	174/262	H05K 1/141
2008/0222885	12/2007	Kanda	29/842	H05K 1/142
2010/0020248	12/2009	Choi	361/752	H04N 5/64
2012/0193797	12/2011	Zhu	257/769	H01L 23/481
2012/0212920	12/2011	Schreffler	29/830	H01R 12/737
2017/0140679	12/2016	Tomoda	N/A	N/A
2020/0271971	12/2019	Su	N/A	N/A
2021/0298210	12/2020	Huang	N/A	N/A

Primary Examiner: Feng; Zhengfu J

Background/Summary

BACKGROUND OF THE DISCLOSURE

1. Field of the Disclosure

(1) The present disclosure relates to an electronic device, in particular is directed to an electronic device with both an electronic panel and a supporting plate.

2. Description of the Prior Art

(2) With the development of technology and demand for use, the application of light-emitting diode (LED) devices are becoming popular in life, such as the use of a tiled electronic device which is formed of lamp boards of sub-mm light-emitting diodes (mini LED) or of micro light-emitting diodes (micro LED). Currently, glass mostly serves as the substrate of the sub-millimeter light-emitting diode lamp boards. In order to meet the requirements of transportation and of the strength for tiling, an aluminum plate is attached to the back side of the glass substrate. However, because the coefficient of thermal expansion (CTE) of the aluminum plate differs greatly from that of the glass, it may cause damage to the lamp board so how to improve the quality of the electronic device and to reduce the possibility of causing damage to the lamp board have become an important issue.

SUMMARY OF THE DISCLOSURE

(3) Some embodiments of the present disclosure propose an electronic device, and the electronic device includes an electronic panel and a supporting plate. The electronic panel includes a

substrate, an electronic component disposed on the first surface of the substrate, and a circuit board disposed on the second surface of the substrate. The first surface is opposite to the second surface, and the electronic component and the circuit board are electrically connected to each other. The supporting plate is arranged under the electronic panel and includes an opening through which the circuit board passes. The difference of the thermal expansion coefficient between the substrate and the supporting plate is less than or equal to 4 ppm/° K.

(4) According to the electronic device of the embodiments of the present disclosure, reducing the difference between the thermal expansion coefficient of the substrate and of the supporting plate helps improve the quality of the electronic device. In this way, it is advantageous to reduce the possibility of damage to the lamp board to facilitate the technological progress and innovation of the tiled electronic device.

(5) These and other objectives of the present disclosure will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the embodiment that is illustrated in the various figures and drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** illustrates an exploded schematic view of an electronic device of an embodiment of the present disclosure.

(2) FIG. **2** illustrates a schematic cross-sectional view of the electronic device of an embodiment of the present disclosure.

(3) FIG. **3** illustrates a schematic top view of the number of the electronic panels and of the supporting plates of the electronic device of an embodiment of the present disclosure.

(4) FIG. **3**A illustrates a schematic top view of the number of the electronic panels and of the supporting plates of an electronic device of a variant embodiment of the present disclosure.

(5) FIG. **3**B illustrates a schematic top view of the number of the electronic panels and of the supporting plates of an electronic device of a variant embodiment of the present disclosure.

(6) FIG. **4** illustrates a schematic structure of the electronic device of a variant embodiment of the present disclosure.

(7) FIG. **4**A illustrates a schematic structure of the electronic device of a variant embodiment of the present disclosure.

(8) FIG. **4**B illustrates a schematic top view corresponding to an embodiment of the adhesive material in the electronic device.

(9) FIG. **5** illustrates a schematic view of the supporting plate of an embodiment of the present disclosure.

(10) FIG. **5**A illustrates a schematic view of the supporting plate of an embodiment of the present disclosure.

(11) FIG. **6** illustrates a schematic structure of a plurality of electronic devices arranged in an array to form a tiled device in an embodiment of the present disclosure.

DETAILED DESCRIPTION

(12) The present disclosure may be understood by reference to the following detailed description, taken in conjunction with the drawings as described below. For purposes of illustrative clarity understood, various drawings of this disclosure show a portion of the electronic device, and certain elements in various drawings may not be drawn to scale. In addition, the number and dimension of each device shown in drawings are only illustrative and are not intended to limit the scope of the present disclosure.

(13) Certain terms are used throughout the description and following claims to refer to particular components. As one skilled in the art will understand, electronic equipment manufacturers may

refer to a component by different names. This document does not intend to distinguish between components that differ in name but not in function.

(14) In the following description and in the claims, the terms “include”, “comprise” and “have” are used in an open-ended fashion, and thus should be interpreted to mean “include, but not limited to . . . ”.

(15) It will be understood that when an element or a film/layer is referred to as being “on another component or on another layer” or “connected to another component or to another film/layer”, it can be directly on or directly connected to the other element or film/layer, or intervening elements or layers may be presented. In contrast, when an element is referred to as being “directly on” or “directly connected to” another element or film/layer, there are no intervening elements or layers presented. When an element is referred to as being “electrically connected to” another element or film/layer, it may be “directly electrically connected to” or “indirectly electrically connected to”.

(16) It should be understood that elements or devices in the drawings may exist in various forms which are well known to those skilled in the art. The relative terms mentioned in this article, such as “below”, “lower”, “bottom”, “on”, “higher”, “top”, etc., only refer to the directions of the drawings. It is understandable that the elements described on the “lower” side will become elements on the “higher” side if the device in the drawing is turned upside down. The embodiments of the present disclosure may be understood together with the drawings, and the drawings of the present disclosure are also regarded as a part of the disclosure description. It should be understood that the drawings of the present disclosure are not drawn to scale and, in fact, the dimensions of elements may be arbitrarily enlarged or reduced in order to clearly show the features of the present disclosure. Furthermore, when it is mentioned that a first material layer is located on or over a second material layer, it includes the situations that the first material layer is in direct contact with the second material layer, or there may be one or more other material layers interposed therebetween. Meanwhile, there may be no direct contact between the first material layer and the second material layer.

(17) The terms “about”, “equal”, or “same”, “substantially”, “generally” mean within 20% of a given value or range, or mean within 10%, 5%, 3%, 2%, 1%, or 0.5% of a given value or range.

(18) Although terms such as first, second, third, etc., may be used to describe diverse constituent elements, such constituent elements are not limited by the terms. The terms are used only to discriminate a constituent element from other constituent elements in the specification. The claims may not use the same terms, but instead may use the terms first, second, third, etc. with respect to the order in which an element is claimed. Accordingly, in the following description, a first constituent element may be a second constituent element in a claim.

(19) The electrical connection or coupling described in this disclosure may refer to direct connection or indirect connection. In the case of a direct connection, the terminals of the components on the two circuits are directly connected or connected to each other by a conductor line segment, and in the case of an indirect connection, there are switches, diodes, capacitors, inductors, resistors, and other suitable devices between the terminals of the components on the two circuits, but the present disclosure is not limited thereto.

(20) In this disclosure, the thickness, length, and width can be measured by using an optical microscope, and the thickness can be measured by a cross-sectional image in an electron microscope, but it is not limited to this. In addition, there may be a certain error in any two values or directions used for comparison. If the first value is equal to the second value, it implies that there may be an error of about 10% between the first value and the second value. In addition, the terms “equal to”, “equal”, “same”, “substantially” or “generally” mentioned in the present disclosure generally mean falling within 10% of a given value or range. In addition, the terms “the given range is from the first numerical value to the second numerical value” and “the given range falls within the range from the first numerical value to the second numerical value” mean that the given range includes the first numerical value, the second numerical value and other values in between. If

the first direction is perpendicular to the second direction, the angle difference between the first direction and the second direction may be between 80 degrees and 100 degrees; if the first direction is parallel to the second direction, the angle between the first direction and the second direction may be between 0 degrees and 10 degrees.

(21) Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure pertains. It should be understood that these terms, such as those defined in commonly used dictionaries, should be interpreted as having meanings consistent with the relevant art and the background or context of the present disclosure, and should not be interpreted in an idealized way or overly formal manner unless they are otherwise defined in the embodiments of the present disclosure.

(22) It should be noted that the technical proposals provided in different embodiments below may be replaced, combined or mixed with each other to form another embodiment without violating the spirit of the present disclosure.

(23) FIG. **1** illustrates an exploded schematic view of an electronic device **100** of an embodiment of the present disclosure. The electronic device **100** of some embodiments of the present disclosure may include an electronic panel **110**, a supporting plate **120**, and an adhesive material **130**. In the present disclosure, the electronic device **100** may include a display device, a backlight device, an antenna device, a sensing device or a tiled device, but the present disclosure is not limited thereto. The electronic device **100** may be a bendable or flexible electronic device. The display device may be a non-self-illuminating display device or a self-illuminating display device. The antenna device may be a liquid crystal type antenna device or a non-liquid crystal type antenna device, and the sensing device may be a sensing device which senses capacitance, light, heat, or ultrasound waves, but the present disclosure is not limited thereto. The tiled device may be, for example, a display tiled device or an antenna tiled device, but the present disclosure is not limited thereto. It should be noted that the electronic device may be any combination of the above, but the present disclosure is not limited thereto. The following uses the display device as the electronic device or the tiled device to elaborate the present disclosure, but the present disclosure is not limited thereto.

(24) The electronic panel **110** may be a display device, for example, may include a substrate **111**, an electronic component **112** and a circuit board **113**. The substrate **111** may include a first surface **111**A and a second surface **111**B, the first surface **111**A may be arranged relative to the second surface **111**B, that is, the first surface **111**A and the second surface **111**B are respectively located on opposite sides of the substrate **111**, for example the first surface **111**A may be one of the front side and the back side of the substrate **111**, and the second surface **111**B may be the other of the front side and the back side of the substrate **111**. In some embodiments, the electronic component **112** may be disposed on the first surface **111**A of the substrate **111** and the circuit board **113** may be disposed on the second surface **111**B of the substrate **111**, but the present disclosure is not limited thereto. The substrate **111** may include a transparent material or an inorganic material, or it may include a hard material or a flexible material, such as glass, quartz, sapphire, ceramic or plastic, or any suitable material. A “flexible material” herein means a material which may be curved, bent, fold, rolled, flexible, stretch, and/or other similar deformation to represent at least one of the above possible deformations. The “flexibility” is not limited to the above-mentioned deformation methods, either. The size of the substrate **111** is not limited, and in some embodiments, the thickness of the substrate **111** may be in a range from 0.2 mm to 2 mm, for example, but the present disclosure is not limited thereto.

(25) In the present disclosure, the electronic component **112** of the electronic panel **110** may include a passive component and an active component, such as a capacitor, a resistor, an inductor, a diode, and a transistor, etc. A diode may include a light-emitting diode or a photoelectric diode. A light emitting diode may include, for example, an organic light emitting diode (OLED), a sub-millimeter light emitting diode, a micro light emitting diode, or a quantum dot light emitting diode,

but the present disclosure is not limited thereto. The electronic panel **110** may further include various components for use in the electronic device, such as a dielectric layer (not shown), a metal layer (not shown), such as a metal wire, a metal line and/or a metal trace, a re-distribution layer (not shown), an array of electronic components (not shown), laser marks for alignment (not shown), etc., but the present disclosure is not limited thereto. When the electronic device **100** is applied as a display device, the electronic panel **110** may further include a switching element and/or a driving element (not shown), a common electrode (not shown in the figure), etc., but not limited to the above.

(26) In the present disclosure, the circuit board **113** of the electronic panel **110** and the electronic components **112** may be electrically connected to each other. For example, the circuit board **113** may be electrically connected to the electronic component **112** on the first surface **111**A of the substrate **111** by a metal line (not shown) or by a metal trace (not shown) which are disposed on the first surface **111**A of the substrate **111**, and the circuit board **113** and the electronic component **112** may also be electrically connected to each other by a metal trace on the side surfaces of the substrate **111**, but the present disclosure is not limited thereto. For example, FIG. **1** shows two circuit boards **113** respectively disposed on opposite sides of the second surface **111**B of the substrate **111**, and the circuit boards **113** and the substrate **111** may be generally perpendicular to each other, i.e., the angle between the two is generally 90 degrees, but the present disclosure is not limited thereto.

(27) In the present disclosure, the supporting plate **120** may be provided under the electronic panel **110**, for example, the supporting plate **120** may be arranged to face the circuit board **113** or the second surface **111**B of the substrate **111**. In some embodiments, the second surface **122** and the first surface **121** are respectively two relatively opposite sides of the supporting plate **120**, and for example, the second surface **122** is an outer surface farther away from the second surface **111**B of the substrate **111** than the first surface **121**. The supporting plate **120** may also include an opening **123** for the circuit board **113** to pass through. In some embodiments, the opening **123** of the supporting plate **120** may be provided to correspond to the positions of the circuit boards **113** such that the opening **123** through which the circuit boards pass. FIG. **1** shows an example of the supporting plate **120** including two openings **123**, each corresponding to a circuit board **113**, but the present disclosure is not limited thereto. In some embodiments, the size of the opening **123** of the supporting plate **120** may be arranged to correspond to the size of the circuit boards **113** such that the opening **123** through which the circuit boards pass. In some embodiments, the shapes of the opening **123** of the supporting plate **120** may be arranged correspond to the shapes of the circuit board **113** such that the opening **123** through which the circuit boards pass. The location, size, or shape of the opening **123** of the supporting plate **120**, or the location, size, or shape of the circuit board **113**, is not limited. In some embodiments, the thickness of the supporting plate **120** may be, for example, 1 mm to 4 mm, but the present disclosure is not limited thereto. In some embodiments, the thickness of the electronic device **100** between the outer surface of the substrate **111** (e.g., the first surface **111**A) and the outer surface of the supporting plate **120** (e.g., the second surface **122**) may be, for example, 1.2 mm to 4.2 mm, but the present disclosure is not limited thereto.

(28) In some embodiments, the thermal expansion coefficient of the substrate **111** may be close to that of the supporting plate **120**. In some embodiments, the thermal expansion coefficient of the substrate **111** and the thermal expansion coefficient of the supporting plate **120** may be generally the same. For example, the difference between the thermal expansion coefficient of the substrate **111** and the thermal expansion coefficient of the supporting plate **120** may be not greater than 4 ppm/° K, for example, may be less than or equal to 4 ppm/° K, but the present disclosure is not limited thereto. In the present disclosure, the supporting plate **120** may include a transparent material or an opaque material, or may include a hard material or an inorganic material, such as glass, or carbon fiber, or any suitable material, but the present disclosure is not limited thereto.

(29) In the present disclosure, the adhesive material **130** may help fix the supporting plate **120** to the electronic panel **110**, for example, the adhesive material **130** may help the supporting plate **120** attached to the electronic panel **110**, but the present disclosure is not limited thereto. In some embodiments, the first surface **121** of the supporting plate **120** may attach to the second surface **111**B of the substrate **111**. In some embodiments, the adhesive material **130** may include partial adhesion or full adhesion. In some embodiments, the implementation for partial adhesion may include a re-workable adhesive/removable adhesive, but the present disclosure is not limited thereto. The embodiment illustrated in FIG. **1** shows the partial adhesion of the adhesive material **130**, for example, generally on the left side and on right side of the first surface **121**, but the present disclosure is not limited thereto. In some embodiments, the full adhesion may include an entire piece of a back adhesive, but the present disclosure is not limited thereto. In some embodiments, the thickness of the adhesive material **130** between the second surface **111**B of the substrate **111** and the first surface **121** of the supporting plate **120** may be not greater than 0.2 mm, for example, may be 0.1 mm to 0.2 mm, but the present disclosure is not limited thereto.

(30) FIG. **2** illustrates a schematic cross-sectional view of the electronic device **100** of an embodiment of the present disclosure. In some embodiments of the present disclosure, the electronic device **100** may further include a thermal conductive material **140**. In some embodiments, the thermal conductive material **140** may be disposed on the surface of the substrate **111**, for example, the thermal conductive material **140** may be disposed on the second surface **111**B of the substrate **111**, but the present disclosure is not limited thereto. In some embodiments, the thermal conductive material **140** may be disposed on the surface of the supporting plate **120**, for example, the thermal conductive material **140** may be disposed on the first surface **121** of the supporting plate **120** to become a first thermal conductive film **141**, and the first surface **121** of the supporting plate **120** may face the second surface **111**B of the substrate **111**. In some embodiments, the thermal conductive material **140** may be disposed on the second surface **122** of the supporting plate **120** to become a second thermal conductive film **142**.

(31) In some embodiments, the supporting plate **120** may have one or more openings **124**. For example, one or more openings **124** may connect the first surface **121** of the supporting plate **120** and the second surface **122** of the supporting plate **120**. The thermal conductive material **140** which is filled in at least one hole **124** of the supporting plate **120** may respectively contact the first thermal conductive film **141** and the second thermal conductive film **142**, so that the thermal conductive material **140** may be regarded as being disposed between the supporting plates **120**. In the present disclosure, the thermal conductivity of the thermal conductive material **140** may be greater than the thermal conductivity of the substrate **111** or greater than the thermal conductivity of the supporting plate **120**, which is advantageous for the rapid heat transfer from the electronic components **112** and/or the circuit board **113** to the surface of the electronic device **100**, for increasing the heat exchange capability between the first surface **111**A and the second surface **111**B of the substrate **111**, or for increasing the heat exchange capability between the first surface **121** and the second surface **122** of the supporting plate **120**, which is advantageous to increase the heat dissipation capacity of the electronic device **100**. The thermal conductive material **140** may include, for example, a material of high thermal conductivity, such as copper (Cu) or aluminum (Al), or other materials of higher thermal conductivity than that of the supporting plate **120**, but the present disclosure is not limited thereto.

(32) FIG. **3** illustrates a top view of the number of the electronic panels **110** and of the supporting plates **120** of the electronic device **100** of an embodiment of the present disclosure. FIG. **3**A illustrates a top view of the number of the electronic panels **110** and of the supporting plates **120** of an electronic device **100**A of a variant embodiment of the present disclosure. FIG. **3**B illustrates a top view of the number of the electronic panels **110** and of the supporting plates **120** of an electronic device **100**B of a variant embodiment of the present disclosure. In the present disclosure, the number of the electronic panels **110** and the number of the supporting plates **120** in the

electronic device **100**, in the electronic device **100**A or in the electronic device **100**B may optionally have different implementations.

(33) In some embodiments, as illustrated in FIG. **1** or in FIG. **3**, the number of electronic panels **110** may be equal to the number of supporting plates **120**, i.e., one electronic panel **110** is arranged to correspond to one supporting plate **120**. In some embodiments, the edge **120**R of the supporting plate **120** may extend outwardly from the edge **110**R of the electronic panel **110**, or the edge **110**R of the electronic panel **110** may retract inwardly from the edge **120**R of the supporting plate **120** such that the edge **110**R of the electronic panel **110** is surrounded and encircled by the edge **120**R of the supporting plate **120**, and there may be a space or a distance between the edge **110**R and the edge **120**R. The edge **110**R of the electronic panel **110** to be surrounded and encircled by the continuous edge **120**R of the supporting plate **120** facilitates the edge **120**R of the supporting plate **120** to protect the edge **110**R of the electronic panel **110** within, so the chance of the damage to the edge **110**R of the electronic panel **110** and of the collateral damage to electronic components (not shown) may be reduced.

(34) In some embodiments, as illustrated in FIG. **3**A, the number of electronic panels **110** may be greater than the number of supporting plates **120**, or it may be considered that the size of electronic panels **110** may be smaller than the size of supporting plates **120**, so that multiple electronic panel **110-1**, electronic panel **110-2**, electronic panel **110-3** and electronic panels **110-4** correspond to one supporting plate **120** at the same time, and the edge **120**R of the supporting plate **120** surrounds multiple edge **110-1**R of the electronic panel **110-1**, edge **110-2**R of the electronic panel **110-2**, edge **110-3**R of the electronic panel **110-3** and edge **110-4**R of the electronic panel **110-4** to facilitate the edge **120**R of the supporting plate **120** to protect the edge **110-1**R of the electronic panel **110-1**, the edge **110-2**R of the electronic panel **110-2**, the edge **110-3**R of the electronic panel **110-3** and the edge **110-4**R of the electronic panel **110-4** within, so the chance of the damage to the edge **110-1**R of electronic panel **110-1**, the edge **110-2**R of electronic panel **110-2**, the edge **110-3**R of electronic panel **110-3** and the edge **110-4**R of electronic panel **110-4** and of the collateral damage to electronic components (not shown) may be reduced.

(35) In some embodiments, there may be no physical contact among the multiple edge **110-1**R of the electronic panel **110-1**, edge **110-2**R of the electronic panel **110-2**, edge **110-3**R of the electronic panel **110-3** and edge **110-4**R of the electronic panel **110-4** to form a visually seamless tiled device. In some embodiments, there may be physical contact among the multiple edge **110-1**R of the electronic panel **110-1**, edge **110-2**R of the electronic panel **110-2**, edge **110-3**R of the electronic panel **110-3** and edge **110-4**R of the electronic panel **110-4** to form a physically seamless tiled device. The left side of FIG. **3**A illustrates a top view of one supporting plate **120** corresponding to four electronic panels **110-1**, **110-2**, **110-3** and **110-4**, and one supporting plate **120** includes two narrow openings **123**; the right side of FIG. **3**A illustrates a top view of one supporting plate **120** corresponding to four electronic panels **110-1**, **110-2**, **110-3** and **110-4**, and one supporting plate **120** includes a larger opening **123** whose shape may generally corresponds to the electronic panel **110-1**, to the electronic panel **110-2**, to the electronic panel **110-3** or to the electronic panel **110-4**, but the present disclosure is not limited thereto.

(36) In some embodiments, as illustrated in FIG. **3**B, the number of the electronic panels **110** may be less than the number of the supporting plates, or the size of the electronic panels **110** may be smaller than the size of the supporting plates, so that multiple supporting plates are arranged to correspond to one electronic panel **110** at the same time. FIG. **3**B illustrates that the shapes of the supporting plates may be irregular rectangles of various types, but the present disclosure is not limited thereto. As illustrated in the example (I) of FIG. **3**B, the location of multiple supporting plate **120-1**, supporting plate **120-2**, supporting plate **120-3** and supporting plate **120-4** may protect the four corners **110**C of electronic panel **110** by extending outwardly from the four corners **110**C of electronic panel **110**. The edge **120-1**R of the supporting plate **120-1**, the edge **120-2**R of the supporting plate **120-2**, the edge **120-3**R of the supporting plate **120-3** and the edge **120-4**R of the

supporting plate **120-4** may discontinuously surround the edge **110**R of the electronic panel **110** and the four corners **110**C to facilitate the protection of the four corners **110**C and of the edge **110**R of the electronic panel **110** within by a plurality of the edge **120-1**R of supporting plate **120-1**, the edge **120-2**R of supporting plate **120-2**, the edge **120-3**R of supporting plate **120-3** and the edge **120-4**R of supporting plate **120-4**, so the chance of the damage to the edge **110**R of the electronic panel **110** and to the four corners **110**C and of the collateral damage to electronic components (not shown) may be reduced.

(37) The supporting plate **120-1**, the supporting plate **120-2**, the supporting plate **120-3** and the supporting plate **120-4** located at the four corners **110**C of the electronic panel **110** may approximately form an accommodating space **125** for the circuit board **113** of the electronic panel **110** to pass through. FIG. **3**B illustrates an embodiment in which one electronic panel may correspond to two to five supporting plates, but the present disclosure is not limited thereto. Example (II) of FIG. **3**B illustrates a single electronic panel **110** corresponding to five supporting plates **120**, wherein three supporting plates **120** correspond to the upper part of the electronic panel **110** and two supporting plates **120** correspond to the lower part of the electronic panel **110**, and the five supporting plates **120** may respectively have different shapes. Example (III) of FIG. **3**B illustrates a single electronic panel **110** corresponding to two supporting plates **120**, wherein one supporting plate **120** corresponds to the upper part of electronic panel **110** and one supporting plate **120** corresponds to the lower part of electronic panel **110**, and the two supporting plates **120** may have mirror-symmetrical shapes. Example (IV) of FIG. **3**B illustrates a single electronic panel **110** corresponding to five supporting plates **120**, wherein three supporting plates **120** correspond to the upper part and to the lower part of the electronic panel **110**, two supporting plates **120** correspond to the left side and to the right side of the electronic panel **110**, and the five supporting plates **120** may respectively have different shapes. Example (V) of FIG. **3**B illustrates a single electronic panel **110** corresponding to five supporting plates **120**, wherein four supporting plates **120** correspond to the corners **110**C of the electronic panel **110**, one supporting plates **120** corresponds to the center of the electronic panel **110**, and the five supporting plates **120** may respectively have different shapes.

(38) The following describes various embodiments of the arrangements of the adhesive material in the electronic devices of the present disclosure. FIG. **4** illustrates a schematic structure of the electronic device **100**C of a variant embodiment of the present disclosure, to disclose the arrangements of the adhesive material **130**. FIG. **4**A illustrates a schematic structure of the electronic device **100**C of a variant embodiment of the present disclosure, to disclose the arrangements of the adhesive material **130**. In some embodiments, as illustrated in FIG. **4**, the adhesive material **130** may include a local adhesion, such as multiple locally-arranged release adhesives or multiple pull adhesives on the first surface **121**, or multiple release adhesives or multiple pull adhesives arranged at least correspondingly close to the four corners **110**C of the electronic panel **110**. Optionally, the locally-arranged adhesive material **130** may also be additionally added to correspond to the edge **110**R of the electronic panel **110**, which helps increase the stability of the supporting plate **120** attached to the substrate **111**, or helps the electronic device **100** for rework. In some embodiments, as illustrated in FIG. **4**A, the adhesive material **130**C may include an entire piece of the adhesive layer, which may be, for example, an entire piece of back adhesive applied on the supporting plate **120**. The entire piece of back adhesive also helps increase the stability of the overall attachment of the substrate **111** to the supporting plate **120**.

(39) FIG. **4**B illustrates a schematic top view corresponding to an embodiment in FIG. **4** of the adhesive material **130** in the electronic device **100** to disclose the shapes of the adhesive material **130** for implementation. When the adhesive material **130** includes a local adhesive layer, for example, a locally arranged release adhesive or a pull adhesive, the substrate **111** may be locally attached to the supporting plate **120** with the help of the locally arranged release adhesive or the pull adhesive. From the top view, the adhesive material **130** may have a designed shape of a variable width, but the present disclosure is not limited thereto. In some embodiments, the adhesive

material **130** may be in a form of a long strip with a long side **131** and with a short side **132** adjacent to the long side **131**. The maximum distance along the extension direction of the long side **131** (i.e., the direction D**1**) is defined as the length **130**L of the adhesive material **130**, and the maximum distance along the extension direction of the short side **132** (i.e., the direction D**2**) is defined as the width **130**W of the adhesive material **130**. In some embodiments, the adhesive material **130** may have a variable width.

(40) The adhesive material **130** may include some parts, such as a first region **133** and a second region **134** which are defined by the extension direction of the long side **131**, wherein there is a junction region **135** disposed between the first region **133** and the second region **134**. The adhesive material **130** may include two regions, for example, the adhesive material **130** respectively includes the first region **133** and the second region **134**, i.e., the first region **133** and the second region **134** may respectively correspond to the left region and to the right region of the adhesive material **130**. The first region **133** is a region of the adhesive material **130** of a fixed width, and the second region **134** is referred to as a region of the adhesive material **130** with a gradual change in width. The right boundary of the second region **134** in FIG. **4**B is the junction region **135** and the width of the adhesive material **130** on the right side of the junction region **135** along the direction D**2** is approximately the same, and the width of the adhesive material **130** on the left side of the junction region **135** along the direction D**2** gradually decreases to the left, so the second region **134** may be regarded as a region of a gradual change in width and the junction region **135** is referred to as the place where the width of the adhesive material **130** begins to decrease. In detail, in some embodiments, the length of the first region **133** is approximately the same along the direction D**1** and the width is approximately the same along the direction D**2**, i.e., the first region **133** generally has a rectangular shape, but the present disclosure is not limited thereto. The second region **134** includes a width tapered end arranged in the second region **134**, such as an end of the second region **134** disposed away from the first region **133**. In some embodiments, the length of the second region **134** along the direction D**1** is variable and the width of the second region **134** along the direction D**2** is variable, for example the width of the second region **134** further away from the first region **133** may gradually and continuously be smaller and smaller, but the present disclosure is not limited thereto. The decreasing width of the second region **134** helps reduce the chance of leaving a residual adhesive on the supporting plate **120** or on the electronic panel **110** when the adhesive material **130** is removed. The junction region **135** may be disposed between the first region **133** and the second region **134** to form a gradually changing junction region where the width along the extension direction of the short side **132** begins to change.

(41) The first region **133** may include a tear-off region **131**R. The tear-off region **131**R may be disposed at a release end of the first region **133** of the adhesive material **130**, such as at an end of the first region **133** away from the second region **134**. The tear-off region **131**R helps reduce the chance of leaving a residual adhesive on the supporting plate **120** or on the electronic panel **110** when the adhesive material **130** is removed, so it is easy to tear off and/or to rework the adhesive material.

(42) When the adhesive material **130** is a pull adhesive, the length of the pull adhesive may have a suitable aspect ratio to the width of the pull adhesive if it is needed to reduce the chance of the break of the pull adhesive when being pulled out at reworking. In some embodiments, the aspect ratio may be greater than or equal to 10, and less than or equal to 14 (for example, 10 aspect ratio 14). The length of the second region **134** (i.e., the gradually changing region) along the extension direction of the long side **131** may have an appropriate gradually changing region ratio to the total length of the pull adhesive. In some embodiments, the appropriate gradually changing region ratio may be greater than or equal to 0.25, and less than or equal to 0.4 (for example, 0.25 gradient area ratio 0.4).

(43) The following describes the installations of the fixing members of the supporting plate in the electronic device of the present disclosure. The present disclosure may apply multiple electronic

devices to the tiled device, so that fixing members may be provided on the supporting plate to arrange the electronic devices on the brackets of the tiled device by the fixing members. FIG. **5** illustrates a schematic view of the backside of the supporting plate **120** of an embodiment of the present disclosure to indicate the installations of multiple fixing members on the supporting plate **120**. FIG. **5**A illustrates a schematic structure of the back side of the supporting plate **120** and of the bracket **160** in an embodiment of the present disclosure to show the installations of multiple locking members, magnetic members on the supporting plate **120** and the bracket **160**. As illustrated in FIG. **5** or FIG. **5**A, in some embodiments, if the material of the supporting plate **120** itself is not suitable for the direct attachment of the fixing members, additional fixing members **150** may be provided on the supporting plate **120**, for example, the additional fixing members **150** may be provided on the second surface **122** of the supporting plate **120**, which helps increase the stability of fixing the supporting plate **120** to the tiled device **10** (as shown in FIG. **6**).

(44) The additional multiple fixing members **150** may be provided in the vicinity of at least four corners **120**C of the supporting plate **120**. Optionally, the locally provided fixing members **150** may also be additionally provided near the edges **120**R of the supporting plate **120**, which helps increase the stability of attaching the supporting plate **120** to the substrate **111**. In some embodiments, the fixing members **150** may include a stud **151**, a structural adhesive **151**A, or the fixing members **150** may further include a stud **152**, but the present disclosure is not limited thereto. In some embodiments, as illustrated in FIG. **5**A, the stud **151** of the fixing member **150** may be glued to the second surface **122** of the supporting plate **120** by means of the structural adhesive **151**A in order to lock or magnetically attach the supporting plate **120** to the tiled device **10** (as shown in FIG. **6**), but the present disclosure is not limited thereto. Alternatively, in some embodiments, as illustrated in FIG. **5**A, on one hand, the locking stud **152** may secure the support **160** of the supporting plate **120** to the second surface **122** of the supporting plate **120**, or on the other hand, the magnetically sensitive stud **151** may magnetically attach the electronic device **100** to the fixing members (not shown) corresponding to the supporting bracket (not shown) of the tiled device (not shown), but the present disclosure is not limited thereto.

(45) FIG. **6** illustrates a schematic structure of a plurality of electronic devices **100** arranged in an array to form a tiled device **10**, i.e. a tiled electronic device, in an embodiment of the present disclosure. In some embodiments, the difference between the thermal expansion coefficient of the substrate **111** (shown in FIG. **1**) and the thermal expansion coefficient of the supporting plate **120** (shown in FIG. **1**) in the electronic device **100** may be less than 4 ppm/° K. (difference <4 ppm/° K.), but the present disclosure is not limited thereto. In some embodiments, the electronic devices **100** satisfying the above conditions may form a tiled device **10**. FIG. **6** illustrates six electronic devices **100** arranged in an array to form a tiled device **10**, i.e., the tiled device **10** may be, for example, a tiled electronic device which includes a plurality of electronic devices **100**, but the present disclosure is not limited thereto.

(46) The tiled device **10** may include a supporting bracket **11**, a magnetic fixing member **12** and an electronic device **100**. As illustrated in FIG. **5**A, the electronic device **100** may include a locking stud **152** and stud **151**. For example, the stud **151** may let the electronic device **100** magnetically attached to the magnetic fixing member **12** corresponding to the supporting bracket **11** of the tiled device **10**, but the present disclosure is not limited thereto.

(47) Given the above, as shown in FIG. **1** to FIG. **6**, if the substrate **111** of the electronic device **100** is made of glass, in order to achieve the strength requirements for transportation and tiling, and/or to reduce the chance of damage to the periphery of the electronic device **100** due to collision and scratch, the supporting plate **120** of a slightly larger size than the electronic panel **110** may be attached to the non-display side (back side) of the electronic panel **110** in an embodiment of the electronic device **100** of the present disclosure. The supporting plate **120** may be made of a material with a thermal expansion coefficient close to that of the substrate **111**. In this way, when the supporting plate **120** is glued to the substrate **111** of the electronic panel **110**, for example for

use as a glass lamp panel, the dimensional expansion value which changes with temperature may be minimized. The smaller difference in expansion value is advantageous to reduce the stress gap between the electronic panel **110** and the supporting plate **120** which are attached together, thus reducing the chance of the electronic device **100** which may warp, damage the adhesive material, fail to adhere, or even cause damage to the electronic components **112**.
(48) Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the disclosure. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

Claims

1. An electronic device comprising: at least one electronic panel comprising a substrate, an electronic component disposed on a first surface of the substrate, a circuit board disposed on a second surface of the substrate, the first surface being opposite to the second surface, and the electronic component and the circuit board being electrically connected to each other; and at least one supporting plate arranged under the electronic panel and comprising an opening through which the circuit board passes, wherein a difference of a thermal expansion coefficient between the substrate and the at least one supporting plate is less than or equal to 4 ppm/° K.
2. The electronic device according to claim 1, wherein a first surface of the at least one supporting plate is provided with a first thermal conductive film and a second surface of the at least one supporting plate is provided with a second thermal conductive film.
3. The electronic device according to claim 2, wherein the at least one supporting plate has at least one hole which is filled with a thermal conductive material and respectively contacts the first thermal conductive film and the second thermal conductive film.
4. The electronic device according to claim 1, wherein a number of the at least one electronic panel is equal to a number of the at least one supporting plate.
5. The electronic device according to claim 1, wherein a number of the at least one electronic panel is greater than a number of the at least one supporting plate.
6. The electronic device according to claim 1, where a number of the at least one electronic panel is less than a number of the at least one supporting plate.
7. The electronic device according to claim 1, wherein the substrate is partially attached to the at least one supporting plate.
8. The electronic device according to claim 7, wherein the substrate is attached to the at least one supporting plate by a plurality of adhesive materials.
9. The electronic device according to claim 8, wherein the adhesive materials have a length to width ratio in a range of 10 to 14.
10. The electronic device according to claim 8, wherein each of the adhesive materials comprises a first region and a second region, the first region comprises a release end and the second region comprises a width-decreasing end.
11. The electronic device according to claim 1, wherein the substrate is entirely attached to the at least one supporting plate.
12. The electronic device according to claim 1, wherein the at least one supporting plate further comprises a plurality of fixing members disposed on a side of the at least one supporting plate away from the substrate.
13. The electronic device according to claim 1, wherein a material of the substrate comprises glass, and a material of the at least one supporting plate comprises at least one of glass or carbon fiber.
14. The electronic device according to claim 1, wherein the opening is provided to correspond to a position of the circuit board.
15. The electronic device according to claim 1, wherein a size of the opening is arranged to

correspond to a size of the circuit board.
16. The electronic device according to claim 1, further comprising: a locking stud.
17. A tiled electronic device comprising a plurality of electronic devices according to claim 1, wherein the plurality of electronic devices are arranged in an array.
18. The tiled electronic device according to claim 17, wherein a first surface of the at least one supporting plate is provided with a first thermal conductive film and a second surface of the at least one supporting plate is provided with a second thermal conductive film.
19. The tiled electronic device according to claim 17, wherein the at least one supporting plate has at least one hole which is filled with a thermal conductive material and respectively contacts the first thermal conductive film and the second thermal conductive film.
20. The tiled electronic device according to claim 16, comprising a magnetic fixing member.