Candidate's answer - Paper A - EQE 2023

CLAIMS

Claim 1

A device (14, 16, 17) wearable on the skin comprising a flexible and electrically insulating substrate (1), a first (2a) and second (2b) sheet made out of electrically conductive material attached to the substrate (1), a layer (15) made out of triboelectric material attached to a first part of the second sheet (2b), wherein a first part of the first sheet (2a) is arranged to overlay the layer (15) and is able to adhere to and separate from said layer (15) when the substrate (1) is deformed, the device (14, 16, 17) further comprising first (4a) and second (4b) electrodes, electrically connected respectively to the first (2a) and second (2b) sheets and arranged so as to apply an electric field E to the skin (11) when the device (14, 16, 17) is worn on the skin.

Claim 2

A device (14, 16, 17) according to claim 1, wherein the device (14, 16, 17) has the shape of a plaster or a bandage.

Claim 3

A device (14, 16, 17) according to any one of claims 1-2, wherein one or more adhesive layers (7) are provided on the bottom face of the substrate (1) intended to face the skin when the device is worn.

Claim 4

A device (14, 16, 17) according to any one of claims 1-3, wherein the first (2a) and second (2b) sheet are attached to the top face of the substrate (1) intended to face away from the skin when the device is worn, wherein the first electrode (4a) and the second electrode (4b) are electrically connected respectively to the first sheet (2a) and the second sheet (2b) via electrical wires (5a) and (5b) extending through the substrate (1).

Claim 5

A device (14, 16, 17) according to claim any one of claims 1-3, wherein the first (2a) and second (2b) sheets are attached to the top face of the substrate (1) intended to face away from the skin when the device is worn, and where the first (2a) and second (2b) sheets furthermore are folded around the substrate (1) and extend along the bottom face of the substrate (1) intended to face the skin when the device (14, 16, 17) is worn, wherein the first and the second electrodes (4a, 4b) are formed by the ends of the first and second sheets (2a, 2b) respectively.

Claim 6

A device (14, 16, 17) according to any one of claims 1-2, wherein the first sheet (2a) and the second sheet (2b) are attached to opposite faces of the substrate (1) and wherein the substrate (1) is bent so that the first part (3a) of the first sheet (2a) overlays the layer (15).

Claim 7

A device (14, 16, 17) according to one of the preceding claims, wherein the first (2a) and second (2b) sheets are made out of any one of copper, aluminum, and zinc.

Claim 8

A device (14, 16, 17) according to any of the preceding claims wherein the layer (15) is made out of any one of Teflon, 4,4'-oxydiphenylene-pyromellitimide, and polydimethylsiloxane.

Claim 9

A device (14, 16, 17) according to any one of claims 1-6, wherein the first (2a) and second sheets (2b) are made out of copper and the layer (15) is made out of 4,4'-oxydiphenylene-pyromellitimide.

Claim 10

A device (14, 16, 17) according to any one of claims 1-4 and 6-9 wherein the first (4a) and second (4b) electrodes are made out of silver.

Claim 11

A device (14, 16, 17) according to any one of the preceding claims, wherein the first (4a) and second (4b) electrodes are coated with an antibacterial composition.

Claim 12

A device (14, 16, 17) according to any of the preceding claims, wherein the substrate (1) is made out of PET.

Claim 13

A device (14, 16, 17) according to any of the preciding claims, wherein the first (4a) and second (4b) electrodes are shaped as inter-digitated electrodes.

Claim 14

Use of a device (14, 16, 17) according to anyone of the preceding claims for smoothing skin wrinkles wherein the device (14, 16, 17) is worn on intact wrinkled skin.

Claim 15

Use according to claim 14 wherein the device (14, 16, 17) is a device (14, 16, 17) according to claim 13.

Introductory part of description

The present invention concerns a device wearable on the skin and a usage of such a skin-wearable device for smoothing skin wrinkles.

Devices which are wearable on the skin are previously known. For example, EP11071982 (henceforth D1) discloses a plaster which can be worn on the skin and which is capable of accelerating the the healing of a wound, if worn properly over the wound. D1 discloses utilizing an electric field to accelerate the healing of the wound. By, through the usage of a battery, providing a voltage over two electrodes arranged in the plaster an electric field

E can be generated in a gap between the electrodes. However, as described, the device shown in D1 requires a battery to function. The battery is arranged between two copper sheets comprised in the plaster and may fall out if the plaster is deformed. Furthermore, due to the battery the device is bulky and may be difficult to use on uneven or curved body surfaces.

Another known device is shown in document D2. This document disclose a wearable sensor to record muscular activity. The muscular activity is recorded by taking advantage of the triboelectric properties of Kapton. A layer of Kapton is arranged between two sheets supported on a insulating substrate. The entire package is embedded in a thick rubber pad providing full electrical shielding. When worn on the body during excercise the package will be compressed and one of the sheets will adhere to the layer of Kapton. As it thereafter separates from the Kapton a small voltage will arise due to the triboelectrical effect. This voltage is detected by a microchip powered by a battery and transmitted to a smarthpone. Thereby the excercise may be recorded. Thus, the device shown in D2 also require a battery to function.

Thus, a problem associated with the prior art is that the devices are bulky, unreliable and require a battery to function.

Consequently, the object of the present invention is to provide a device wearable on the skin which is compact and functions reliably also on curved and uneven body parts. Furthermore, an object is to provide a usage of such a device for smoothing skin wrinkles.

According to the present invention, there is provided a device wearable on the skin as set forth in claim 1.

Furthermore, according to the present invention, there is provided a use of a device wearable on the skin for smoothing skin wrinkles as set forth in claim 14.

Thus, the problem is solved by providing a device wearable on the skin comprising a flexible and electrically insulating substrate, and a first and second sheet made out of electrically conductive material attached to the substrate. A layer made out of triboelectric material is attached to a first part of the second sheet. A first part of the first sheet overlays the layer and is able to adhere to and separate from the layer when the substrate is deformed. Thereby the first sheet will become electrically charged through the triboelectrical effect when the substrate is deformed. The device further comprises first and second electrodes which are electrically connected respectively to the first and second sheets. The electrodes are arranged so as to apply an electric field E to the skin when the device is worn on the skin. Thus, when the first sheet becomes electrically charged, a voltage will be generated betwen the electrodes, since they are electrically connected to the first and second sheet. An electrical field will therefore be generated between the electrodes. Since they are arranged to apply the electric field E to the skin when the device is worn, the skin will be immersed in the electric field when the device is worn and the substrate is deformed. Thereby a wearable device is provided which does not require a battery to function, and thereby any risk of the battery falling out or running out of charge is eliminated. Furthermore, the wearable device can be used on any type of curved surface since it is flexible and compact. As has been described above, the electric field can be applied to the skin of the wearer, e.g. since there is no electrically shielding materials in the device stopping this. Thereby any therapeutic or cosmetic effect of the electric field can be achieved on the skin when the device is worn. Thus, by wearing the device on intact wrinkled skin it will achieve the cosmetic effect of smoothing skin wrinkles.

Thus, the objects stated above are attained.