
From: Jeffrey Epstein <jeevacation@gmail.com>
Sent: Tuesday, August 16, 2011 7:28 PM
To: [REDACTED]
Subject: Re: Epidermal Electronics and Electronic Second Skin

011331 441 70210

On Tue, Aug 16, 2011 at =:26 PM, [REDACTED] <[REDACTED]>
<mailto:[REDACTED]> >> =rote:

Offline...

From: Jeffrey=Epstein
Sent: Tuesday= August 16, 2011 12:00 PM
To: [REDACTED]
Subject: Re: FW:=Epidermal Electronics and Electronic Second Skin

what will happen , vs balmer.?

2011/8/16 [REDACTED] <<= href="mailto:[REDACTED]">
target="_blank">[REDACTED]>

steve is great.
:-)

From: Jeffrey Eps=ein [jeevacatio=@gmail.com <mailto:jeevacation@gmail.com>]
Sent: Tuesday, August 16, 2011 2:03 AM
To: [REDACTED]
Subject: Re: FW: Epidermal Electronics and Electronic Second Skin

I read it and loved the idea..... how is it going with=steve

2011/8/16 [REDACTED] <<= href="mailto:[REDACTED]">
target="_blank">[REDACTED]>

=C2♦

From: [REDACTED]
Sent: Monday, August 15, 2011 9:06 PM
To: Bill Gates ([REDACTED] <mailto:[REDACTED]>)
Cc: Boris Nikolic (BGC3) ([REDACTED] <mailto:[REDACTED]>); Lowell
Wood ([REDACTED])
Subject: Epidermal Electronics and Electronic Second Skin
Importance: Low

Pretty=neat – I'm not sure if you've seen this.

There =re a couple of areas where further development is needed...RF commun=cation frequencies change when the circuits are stretched, and dead skin a=d sweat have to be dealt with during long-term use. These aren't insurmountable complications, though. =/u>

Am att=ching two related papers. Both from Science today. One describes in more detail the "elec=ronic second skin" and the other about "epidermal electron=cs."

The au=hors acknowledge medical applications but they seem most interested in mak=ng this into game controllers. :)

Tem=orary tattoos fitted with electronics make flexible, ultrathin sensors<=u>

By Kyle Niemeyer

Modern=methods of measuring the body's activity, such as electroencephalograph=y (EEG), electrocardiography (ECG), and electromyography (EMG), use electr=cal signals to measure changes in brain, heart, and muscle activity, respectively. Unfortunately, they rely on bulk= and uncomfortable electrodes that are mounted using adhesive tape and con=uctive gel—or even needles. Because of this, these types of measur=ments are limited to research and hospital settings and typically used over short periods of time because the contact= can irritate skin.

These =imitations may be at an end, however. New research published in Science describes technology that allows electrical measurements (an= other measurements, such as temperature and strain) using ultra-thin poly=ers with embedded circuit elements. These devices connect to skin without =dhesives, are practically unnoticeable, and can even be attached via temporary tattoo.

All of=the necessary components of the devices, including electrodes, electronic =components, sensors, radio frequency communication components, and power su=plies, are set within an extremely thin (about 30 μm) elastic polyester sheet. The sheet has a low elast=c modulus (that is, it's flexible) and no noticeable mass (about 0.09 =), so you have a lightweight, stretchable membrane.

Circui= elements (such as transistors, diodes, resistors) and sensors are constr=uted with typical materials like silicon and gallium arsenide, but are link=d using nanoribbon and micro/nanomembrane elements to allow extremely small but flexible designs.

The authors refer to their approach as an "epidermal electronic system" (EES), which is basically a fancy way of saying that the device matches the physical properties of the skin (such as stiffness), and its thickness matches that of skin features (wrinkles, creases, etc.). In fact, it adheres to skin only using van der Waals forces—the forces of attraction between atoms and molecules—so no adhesive material is required. Between the flexibility and the lack of adhesive, you wouldn't really notice one of these attached.

One of the coolest aspects of this technology is the application method: temporary (transfer) tattoo. Yes, the ones you used as a kid, where you hold the transfer sheet with the design onto your skin then dampen it to dissolve the sheet. Here, they used water-soluble polyvinyl alcohol (PVA) sheets in the same manner.

For a power supply, initial designs used silicon photovoltaic cells to generate electricity, but these are limited to microwatts due to the small area. Researchers also explored wireless inductive power, where an external transmission coil matches the resonance frequency of a small inductive coil in the device (it's the same sort of tech that's used in wireless device chargers). This opens up the door for applications that need more power than solar can provide, or for devices that work in low-light conditions (under clothing, for example). The authors also suggest future electrical storage using capacitors or batteries.

As demonstrations, the authors used their devices to measure heartbeats on the chest (ECG), muscle contractions in the leg (EMG), and alpha waves through the forehead (EEG). The results were all high quality, comparing well against traditional electrode/conductive gel measurements in the same locations. In addition, the devices continuously captured data for six hours, and the devices could be worn for a full 24 hours without any degradation or skin irritation.

One interesting demonstration that also suggests future applications was the measuring of throat muscle activity during speech. Different words showed distinctive signals, and a computer analysis enabled the authors to recognize the vocabulary being used. <=p>

The team even hooked one of these sensors up to a simple computer game (Sokoban) and used throat activity as the controller. Identifying each word took about three seconds using a MATLAB program, but it had a higher than 90 percent accuracy. While the potential videogame applications are endless, you can also think of other areas, such as silent communications or better voice recognition software.

[REDACTED] <=p>

[REDACTED] <=b>

Bill & Melinda Gates Foundation</>

Phone [REDACTED] <tel:%28206%29%20709-%203643>

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Email [REDACTED] <mailto:[REDACTED]>

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Jeffrey Epstein

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