Microfabricated Silicon-Based Hollow Microneedles with Integrated Fluid Channels for Transdermal Fluid

Published date: March 14, 2017

Technology description

Microneedles of various heights often fail to pierce skin or other biological surfaces due to the soft underlying tissue structure and elastic nature of skin. If microneedles are made longer, but of the same diameter, they tend to buckle at pressures less than that required to pierce the desired surface. Although a standard metal hypodermic needle is quite effective in piercing the skin and accessing the tissue and blood vessels beneath it, using such a needle with a silicon microchip would prove challenging due to the disparity in size. In addition, many of these needles also feature hollow tips which have the tendency to clog over time.

A minimally invasive method for sampling biological fluids has been developed by researchers at the University of California, Davis. Continuous interstitial fluid (ISF) sampling and measurement of ISF specific metabolic and immunological biomolecules is possible without the pain or tissue damage associated with conventional transdermal sampling methods. The design utilizes novel microtechnology in conjunction with an interface that obviates obstruction from skin and enables high viscosity fluids normally not amenable to capillary force to be sampled.

This development revisits the hollow point needle design and introduces an improved microneedle design and delivery system through which we are able to attain improved sampling of substances of interest and the delivery of drugs or other substances through surface (skin, outer layer of a plant, animal, organ, etc.).

Research conducted at the University of California, Davis has led to an improved method and apparatus for puncturing a surface for extraction, in situ monitoring, and substance delivery.

Application area

On-site monitoring

On-site analysis

On-site delivery of substances

Detecting substances and pathogens, including diseases and contaminants in food

Advantages

Improved delivery of drugs or other substances through a surface Continuous in situ sampling without the complications of lancets
Customized lengths for access to interstitial fluid bathing the epidermal cells (200-250 micron length) or whole blood from dermal capillaries (250-350 micron length)
Microneedles are machined from a single crystal of silicon and ordered in an array for faster sampling
Design makes needles less prone to clogging
Optimal size and shape configurations can be accommodated for various applications

Institution

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