







Read our COVID-19 research and news.

Advertisement

RESEARCH ARTICLE | BIOENGINEERING

Biocompatible near-infrared quantum dots delivered to the skin by microneedle patches record vaccination

Kevin J. McHugh^{1,*,†}, Lihong Jing^{1,2,*}, Sean Y. Severt¹, Mache Cruz¹, Morteza Sarmadi^{1,3}, Hapuarachchige Surangi N. Jayawar...

+ See all authors and affiliations

Science Translational Medicine 18 Dec 2019: Vol. 11, Issue 523, eaay7162

DOI: 10.1126/scitranslmed.aay7162

Article

Figures & Data

Info & Metrics

eLetters



You are currently viewing the abstract.

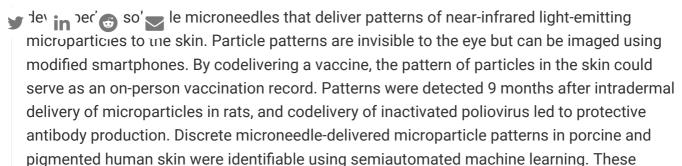
View Full Text



Become a Member

Log In ScienceMag.org Q





results demonstrate proof of concept for intradermal on-person vaccination recordkeeping.

Abstract

Accurate medical recordkeeping is a major challenge in many low-resource settings where well-maintained centralized databases do not exist, contributing to 1.5 million vaccinepreventable deaths annually. Here, we present an approach to encode medical history on a patient using the spatial distribution of biocompatible, near-infrared quantum dots (NIR QDs) in the dermis. QDs are invisible to the naked eye yet detectable when exposed to NIR light. QDs with a copper indium selenide core and aluminum-doped zinc sulfide shell were tuned to emit in the NIR spectrum by controlling stoichiometry and shelling time. The formulation showing the greatest resistance to photobleaching after simulated sunlight exposure (5-year equivalence) through pigmented human skin was encapsulated in microparticles for use in vivo. In parallel, microneedle geometry was optimized in silico and validated ex vivo using porcine and synthetic human skin. QD-containing microparticles were then embedded in dissolvable microneedles and administered to rats with or without a vaccine. Longitudinal in vivo imaging using a smartphone adapted to detect NIR light demonstrated that microneedledelivered QD patterns remained bright and could be accurately identified using a machine learning algorithm 9 months after application. In addition, codelivery with inactivated poliovirus vaccine produced neutralizing antibody titers above the threshold considered protective. These findings suggest that intradermal QDs can be used to reliably encode information and can be delivered with a vaccine, which may be particularly valuable in the developing world and open up new avenues for decentralized data storage and biosensing.

Copyright © 2019 The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works

http://www.sciencemag.org/about/science-licenses-journal-article-reuse

This is an article distributed under the terms of the Science Journals Default License. **View Full Text**

Become a Member

Log In ScienceMag.org Q

Snake fang-inspired stamping patch for transdermal delivery of liquid formulations

Won-Gyu Bae et al., Sci Transl Med, 2019

Cell and fluid sampling microneedle patches for monitoring skin-resident immunity

Anasuya Mandal et al., Sci Transl Med, 2018

Protecting kids with a patch

Kathryn A. Whitehead, Sci Transl Med, 2016

Long-acting reversible contraception by effervescent microneedle patch

Wei Li et al., Sci Adv, 2019

Application to In Vivo Imaging in the Second Optical Window (1000-1400 nm)

Setsuko Tsuboi et al., ECS Journal of Solid State Science and Technology, 2017

Microneedle contraceptive patch may offer new option for women

Healio

Microneedle patch could increase measles vaccinations

Healio

Applications of Highly Bright PbS Quantum Dots to Non-Invasive Near-Infrared Fluorescence Imaging in the Second Optical Window

Takashi Jin et al., ECS Journal of Solid State Science and Technology, 2015

AZ1350J as a Deep-U.V. Mask Material

B. J. Lin, Journal of The Electrochemical Society, 1980

Powered by TREND MD

I consent to the use of Google Analytics and related cookies across the TrendMD network (widget, website, blog). Learn more

Yes

No



Science Translational Medicine

Vol 11, Issue 523 18 December 2019

Table of Contents

ARTICLE TOOLS



Email



Print



Share



Download Powerpoint



© Request Permissions



Citation tools

MY SAVED FOLDERS



Save to my folders

Become a Member

Log In ScienceMag.org Q

