(SD2024-124) Predicting neural activity at depth from surface using multimodal experiments and machine learning models

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CONTACT
Skip Cynar
scynar@ucsd.edu
tel: 858-822-2672.

ABSTRACT

Researchers from UC San Diego's Neuroelectronic Lab (https://neuroelectronics.ucsd.edu/) demonstrate that they can predict neural activity at deeper layers of the brain by only recording potentials from brain surface. This was achieved by performing multimodal experiments with an ultra-high density transparent graphene electrode technology and developing neural network methods to learn nonlinear dynamic between different modalities. They used cross modality inference to predict the activity at deep layers from surface. Prediction of neural activity at depth have the potential to open up new possibilities for developing minimally invasive neural prosthetics or targeted treatments for various neurological disorders.

TECHNOLOGY DESCRIPTION

When combined together (namely Non-invasive recordings of neural activity at depth through cross modality inference) this newly disclosed technology may have the potential to extend the lifetime of neural implants and improve the longevity of brain-computer interface (BCI) technologies, which could pave the way for medical translation.

Non-invasive recordings of neural activity at depth have the potential to open up new possibilities for developing minimally invasive neural prosthetics or targeted treatments for various neurological disorders.

APPLICATIONS

brain computer interfaces, medical diagnostics, imaging

ADVANTAGES

(1) transparent graphene electrodes,

(2) multimodal experiments, and

(3) computational methods to analyze neural data to demonstrate the prediction of cellular

OTHER INFORMATION

KEYWORDS

brain computer interface, medical diagnostics, imaging

CATEGORIZED AS

- **Imaging**
  - Medical
- **Medical**
  - Disease: Central Nervous System
- **Nanotechnology**
  - Electronics

RELATED CASES

2021-Z08-1

calcium activity at depth from surface potentials.

STATE OF DEVELOPMENT

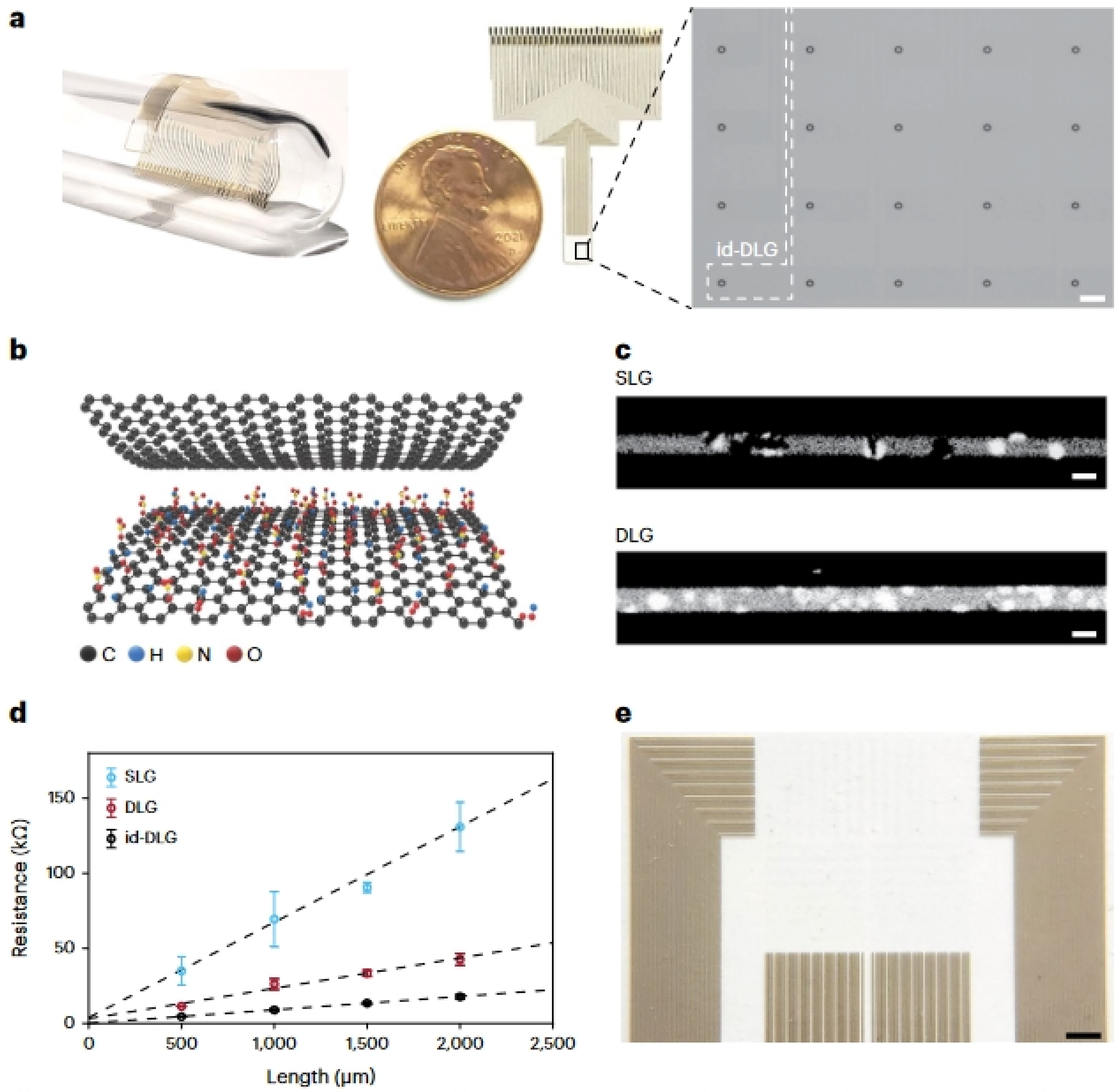

Fig. 1 | High-density transparent graphene array. a, Transparent and flexible 64-channel graphene array (left) and a magnified part of it with graphene wires shown with white dashed lines (right). Scale bar, 100 µm. **b**, Schematic of HNO_3 id-DLG. **c**, Two-photon microscopy image of pinhole defects on the graphene wires. The top and bottom wires are SLG and DLG, respectively. Scale bars, 10 µm. **d**, Graphene wire resistance for SLG, DLG and id-DLG wires as a function of wire length. The circles and error bars indicate the mean and standard deviation, respectively ($n = 4$). **e**, Optical image of high-density 256-channel graphene array. Scale bar, 1 mm.

INTELLECTUAL PROPERTY INFO

UC San Diego is securing patent rights on this invention and such rights are licensable for further commercial development.

RELATED MATERIALS

- Transparent Brain Implant Can Read Deep Neural Activity From the Surface (News Release. January 11, 2024) https://today.ucsd.edu/story/transparent-brain-implant-can-read-deep-neural-activity-from-the-surface - 01/11/2024
- Ramezani, M., Kim, JH., Liu, X. et al. High-density transparent graphene arrays for predicting cellular calcium activity at depth from surface potential recordings. Nat. Nanotechnol. (2024). - 01/11/2024

University of California, San Diego
Office of Innovation and Commercialization
9500 Gilman Drive, MC 0910, ,
La Jolla,CA 92093-0910

Tel: 858.534.5815
innovation@ucsd.edu
https://innovation.ucsd.edu
Fax: 858.534.7345

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