AI-Enabled Breath Sensor

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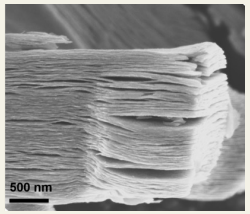
Making a hand held, low-cost alternative to existing diabetes diagnosis methods using nanomaterials and a machine learning regression

INTRODUCTION

ABSTRACT

Current diagnosis methods for diabetes involve long wait times between data collection and diagnosis, as well as high costs associated with equipment and specialized operator requirements. The emergence and development of MAX phase 2-dimensional nanomaterials show significant promise for a low-cost rapid assessment device for use in the diagnosis of diabetes in its early stages

An electron microscope image of Titanium Carbide's accordion-like structure



BACKGROUND

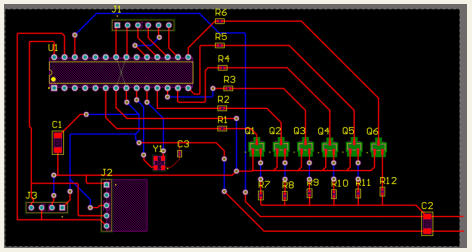
MXene nanomaterials are classified by their production process, starting with a MAX phase powder of a certain group of elements among transition metals, bound to an extraneous element and some Carbon or Nitrogen. The MXene is obtained by etching out the 'A' element from the MAX powder using an agent like hydrofluoric acid, resulting in a two-dimensional structure of the remaining carbide/nitride compound.

RESEARCH

NANOMATERIAL

A compound of Titanium Carbide (Ti_3C_2) and Tungsten Oxide (KWO) results in a stable two-dimensional structure with controllable resistive properties.

SENSOR

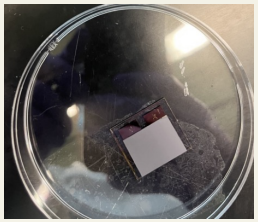


A 2-layer PCB made to prioritize a small profile when compared to previous prototypes. This version uses headers for most parts to allow comparison between different pieces of hardware without needing to manufacture a new board.

An Atmel chip is used to handle all on board programming. Resistors of increasing resistivity are used to maintain relatively precise measurements between 1024 intervals (limit by Arduino C). The resistors act as an onboard ohm-meter to measure the resistivity of the nanomaterial slide.

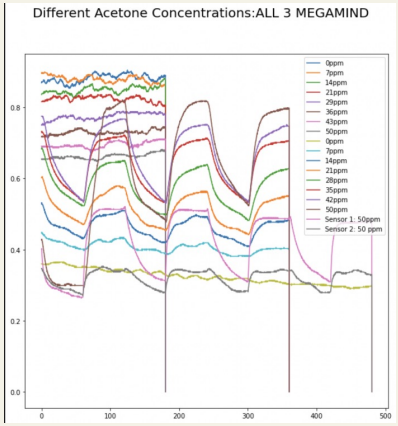
SENSOR SLIDE

Nanomaterial compound pasted onto a standardized interdigited slide to minimize variance between sensors.



RESULTS

Results are pending further data collection. Existing data volume was insufficient to train a regression model. Visual analysis of graphs hint towards usable features in the regression. Acetone presence at increasing concentrations directly increase measured resistivity in the nanomaterial.



CONCLUSION

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A clinical trial where the completed device is compared to existing diagnosis methods like blood testing is planned for the future. Preliminary data suggests high potential for our sensor to be used as a low-cost and easy method of determining if someone is at high risk of suffering from diabetes. Should a strong correlation between resistivity and acetone concentration be found, the affect of diabetes in populations without access to advanced technology and personnel will diminish.

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