Development of a Transient Optical Memory Material Based on Ta-TiO_2 Nanoparticles

Scientific Research Work in the Field of Materials Science, Engineering and Technology Industry Group

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RELEVANCE

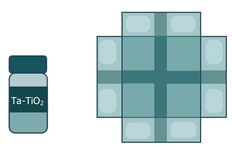
- The development of an alternative information storage system that consumes less energy, thereby ensuring faster data transfer and improving the performance of various high-intensity tasks.
- The development and advancement of primitive components for quantum computers and optical pulse electronics.

OBJECTIVE AND HYPOTHESIS

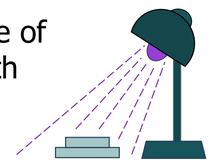
- **Research Objective:** To develop various types of samples that, when exposed to ultraviolet (UV) light, exhibit changes in electrical resistance, as well as to examine the trends in electrical resistance changes of individual pixels within the samples.
- **Refined Objective:** To design and analyze different sample types that demonstrate changes in electrical resistance when exposed to ultraviolet (UV) light and to investigate the resistance variation trends at the pixel level within these samples.

GOALS

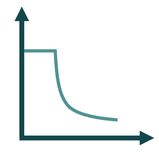
1. Create samples coated with TiO_2 nanoparticles, each containing four.



2. Measure the electrical resistance of the obtained samples under both UV illumination and standard lighting conditions.



3. Evaluate the reversibility of resistance changes in the samples and observe the resistance variation trends.



SAMPLE DEVELOPMENT

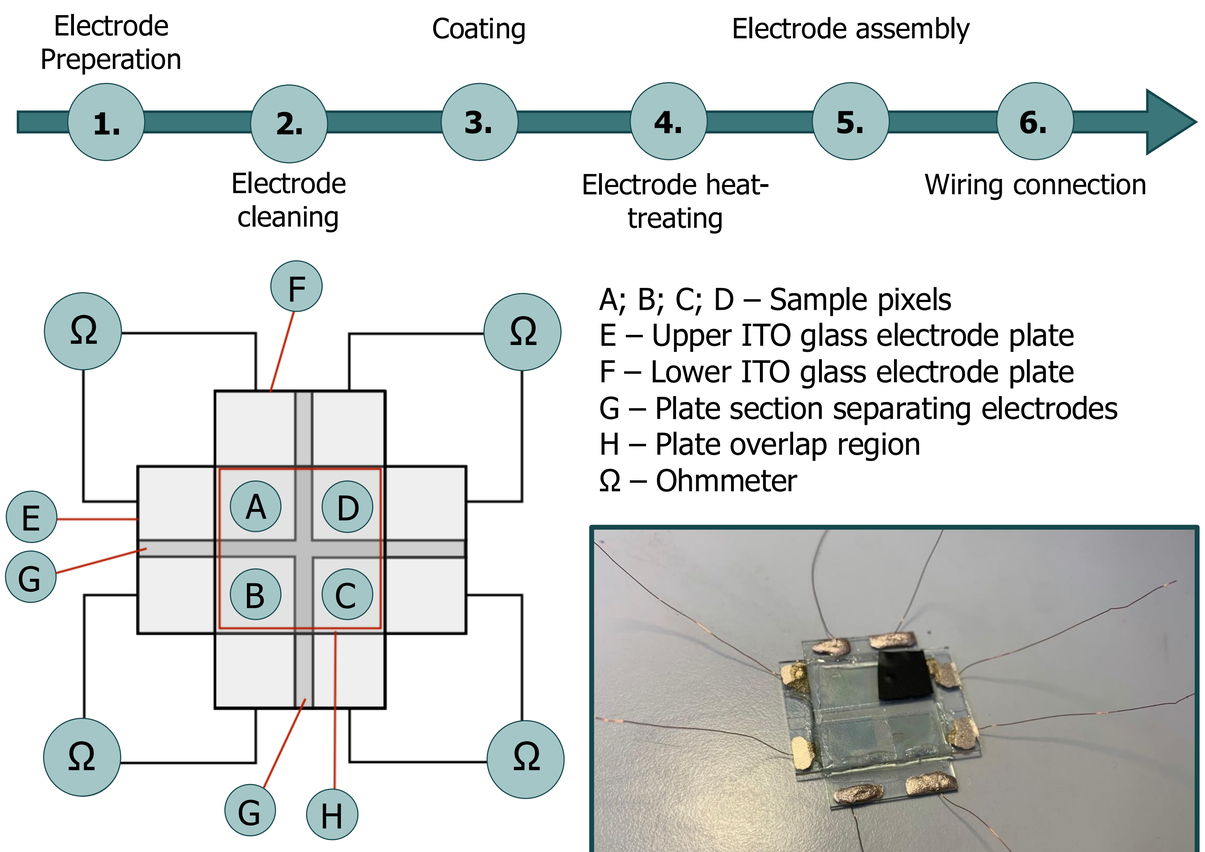


Figure 1. Indium Tin Oxide (ITO) Laboratory Glass Electrode Sample Construction

A; B; C; D – Sample pixels
E – Upper ITO glass electrode plate
F – Lower ITO glass electrode plate
G – Plate section separating electrodes
H – Plate overlap region
Ω – Ohmmeter

Image 1. ITO glass electrode sample

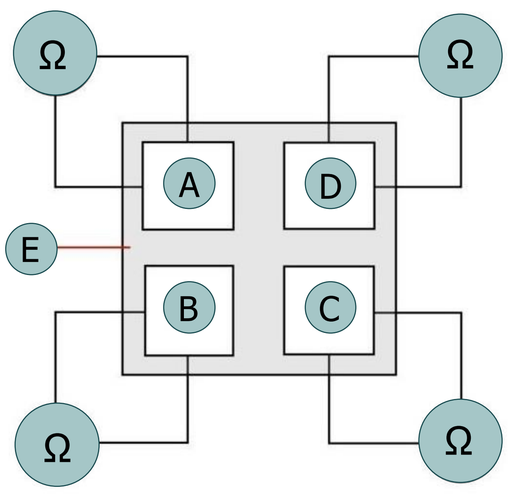


Figure 2. Commercial Electrode Sample Construction

A; B; C; D – Sample pixels
E – Sample glass substrate
Ω – Ohmmeter

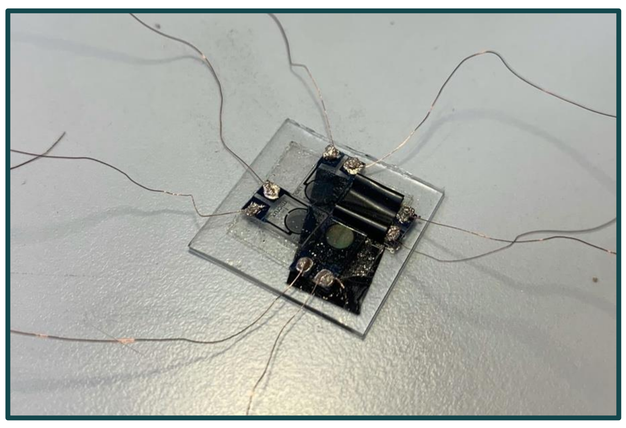


Image 2. Commercial Micrux IDE-8 electrode sample

CONCLUSIONS

1. The proposed hypothesis is confirmed, namely, by irradiating ITO electrode pixels covered with Ta-TiO2 nanoparticles with ultraviolet light, a decrease in electrical resistance can be observed, as well as the reversibility of this effect.
2. Using the methodology applied in the research work, an optically active material can be created from several ITO conductive glasses or commercially developed electrodes, in which changes in the electrical resistance of individual pixels can be observed under the influence of ultraviolet radiation.
3. Both the laboratory-made ITO electrode and the commercially used Micrux IDE-8 electrode samples show a rapid decrease in electrical resistance under the influence of ultraviolet radiation. In a short time interval, the relative change in resistance of the pixels not covered by tape can reach up to 0.98.
4. In the laboratory-made ITO electrode samples, the pixels that are covered during irradiation also show a decrease in electrical resistance due to internal light reflection, but this occurs more slowly than in the uncovered pixels. This phenomenon is not observed in the case of the commercial electrode sample.

RESULTS