Ovshinsky S R. Reversible electrical switching phenomena in disordered structures. *Phys. Rev. Lett.* **21**:1450-3, 1968.
[Energy Conversion Devices, Inc., Troy, MI]

A rapid reversible transition between a highly resistive and conductive state effected by an electric field, which we have observed in various types of disordered semiconducting material, is described. The switching parameters and chemical composition are presented, and microscopic mechanisms for the conduction phenomena suggested. [The *SCI*® indicates that this paper has been cited over 410 times since 1968.]

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"When I started my work in amorphous materials, crystalline symmetry was the *sine qua non* of solid-state physics. Amorphous materials were considered to be, if they were considered at all, ununderstandable, unusable, and unimportant.

"My 1968 paper had its origins in work I had started in 1955 to understand how external energy events could be transformed in a disordered material into detectable information. I was particularly interested in understanding neuronal mechanisms.

"I made models in 1958 which I thought could have analogous mechanisms demonstrating energy conversion processes in nerve cells and how they affected switching events and information encoding. The key was to understand surface phenomena involving disorder, and, therefore, I concentrated on amorphous materials. In 1960, my wife, Iris, and I founded Energy Conversion Laboratories to work in amorphous materials in both the energy and information fields, feeling that they were thermodynamically the opposite sides of the same coin. We built chalcogenide devices chosen for their biological-like, more flexible, helical structures. We made thin film, rapidly reversible threshold and memory devices which changed from insulating to conducting upon the application of an electric field. In the memory, either state remained indefinitely without sustaining power.

"Using a polymeric chemical approach, I was able to design materials in which an electronic switching action could take place in a thin film of less than one micron of amorphous material at speeds faster than any oscilloscopes we had—that is, the picosecond range.

"As my patents started issuing, I discussed my work at international meetings, and through my collaborator, Hellmut Fritzsche, University of Chicago, we interested Sir Nevill Mott in this area. My colleagues urged me to publish what they felt was a very important effect and open up an understanding of what was considered the last frontier of solid-state physics, the amorphous state.

"At the time of publication, we announced our results at a small press conference. The *New York Times*[1] and the *Wall Street Journal*[2] checked with prominent scientists and gave us important coverage. There was a furious reaction from crystalline-based companies. However, our work continued and expanded, and the amorphous field is now fully accepted and rapidly growing. A Nobel prize was given in amorphous materials to Mott only nine years after the attempts to discredit the validity of amorphous materials. Our field has gone from early international conferences of about 30 people with no proceedings to the most recent one with over 500 people from over 40 countries and two volumes of proceedings.[3]

"The terms ovonic, Ovonics, and Ovshinsky effect are in many major dictionaries. In 1968, I received the Diesel Gold Medal for Invention for my work, and have recently received several honorary degrees.

"I believe that this paper was quoted so frequently because it was contrary to the conventional wisdom of its time and yet turned out to be right in its findings and implications, creating a great impetus for amorphous materials research."

1. **Stevens W K.** Glassy electronic device may surpass transistor. *NY Times* 11 November 1968, p. 1, 42.
2. **Nikolaieff G A.** Recognition has arrived like a tidal wave for inventor, 45, of the 'glass transistor.' *Wall Street J.* 14 November 1968, p. 7.
3. **Ovshinsky S R.** Principles and applications of amorphicity, structural change, and optical information encoding. *Proceedings of the Ninth International Conference on Amorphous & Liquid Semiconductors.* Grenoble, France, 2-8 July 1981. To be published in *Journal de Physique.*