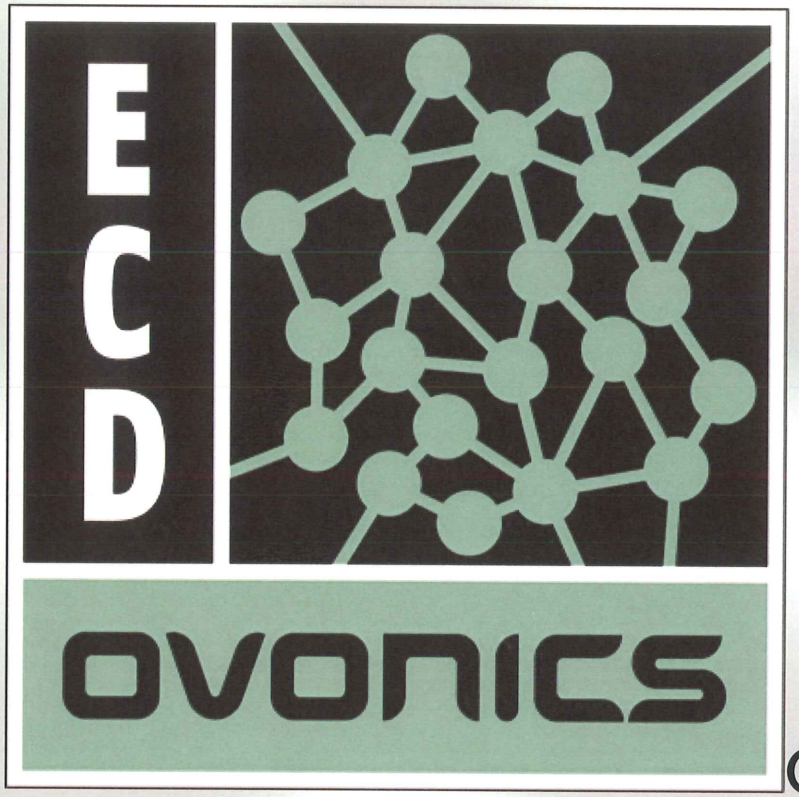

Ovonic Quantum Control

Media Briefing

June 6, 2006

Rochester Hills, Michigan

The Ovonic Quantum Control Device

Extension of the Ovshinsky Effect to Create Totally New Switching and Control Devices

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BACKGROUND

...the "***Ovshinsky effect...is the newest, the biggest, the most exciting discovery in solid-state physics at the moment***," said Sir Nevill Mott, Director of the Cavendish Laboratory at Cambridge University in England. The discovery of the Ovshinsky effect was ***"quite unexpected***," said Professor Mott. Mott also said that "***the principle of the transistor, discovered in 1947, could originally have been figured out on the basis of old knowledge, but that the Ovshinsky effect represented totally new knowledge***."

New York Times, November 11, 1968

NEW PHYSICS

Rich and deep new physics is being used to provide a unique new Quantum Control Device invented by Stanford Ovshinsky

- The world's most powerful plasma by many orders of magnitude in the solid state
- Modulation of threshold voltage
- Latching/non-latching threshold switching
- Smaller and faster than a transistor
- 50 times greater current of a transistor

For the first time we use unique new quantum effects to enable operational modes not previously seen

The Ovonic Quantum Control Device

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Ovonic Threshold Switch, Ovonic Universal Memory (phase-change), Ovonic Cognitive Device and now our OVONIC QUANTUM CONTROL DEVICE are directly compatible with embedding together on the same chip using standard high volume manufacturing tools

Our new physics makes new types of all thin film devices, computers and information products possible at low cost due to small size and 3D architecture

Our Ovonic Quantum control devices and circuits are low-cost, save chip real estate and solve the problem of driving (rapidly switching), high capacitance inherent in conventional on-chip devices (larger current in a small nanostructure area)

High speed processing

- Gigahertz plus digital switching
- i.e. microprocessors, microcontrollers, digital signal processors

Other unique functionalities – which can be used to replace transistors

It is a combined digital, analog, extremely fast highest power switch

All in one nanostructure device

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Wide modulation of voltage

Multifaceted current modulation

Latching

All controlled through a third electrode operating in a quantum controlled manner

THE CONDUCTING CURRENT IS THE HIGHEST DENSITY SOLID STATE PLASMA BY MANY ORDERS OF MAGNITUDE PERMITTING THE **50 TIMES** CURRENT CARRYING OPERATION COMPARED TO A TRANSISTOR AND SOLVING THE INHERENT TIME DELAYS OF CAPACITIVE SWITCHING

Revolutionary high current density capability of the unique conducting plasma results in scalability of the sub-nanogeometrics (see below)

Discharge capacity

- Directly addresses the capacitor switching problem limiting speed etc. inherent in conventional chips (larger current in a small nanostructure)
- Very high speed processing
- Gigahertz digital switching

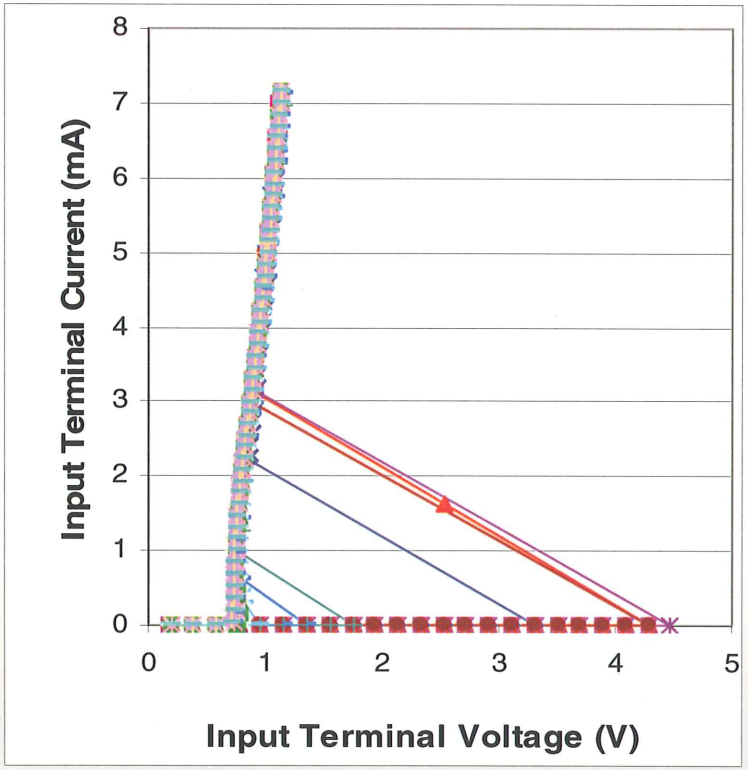
Multi-Functionality

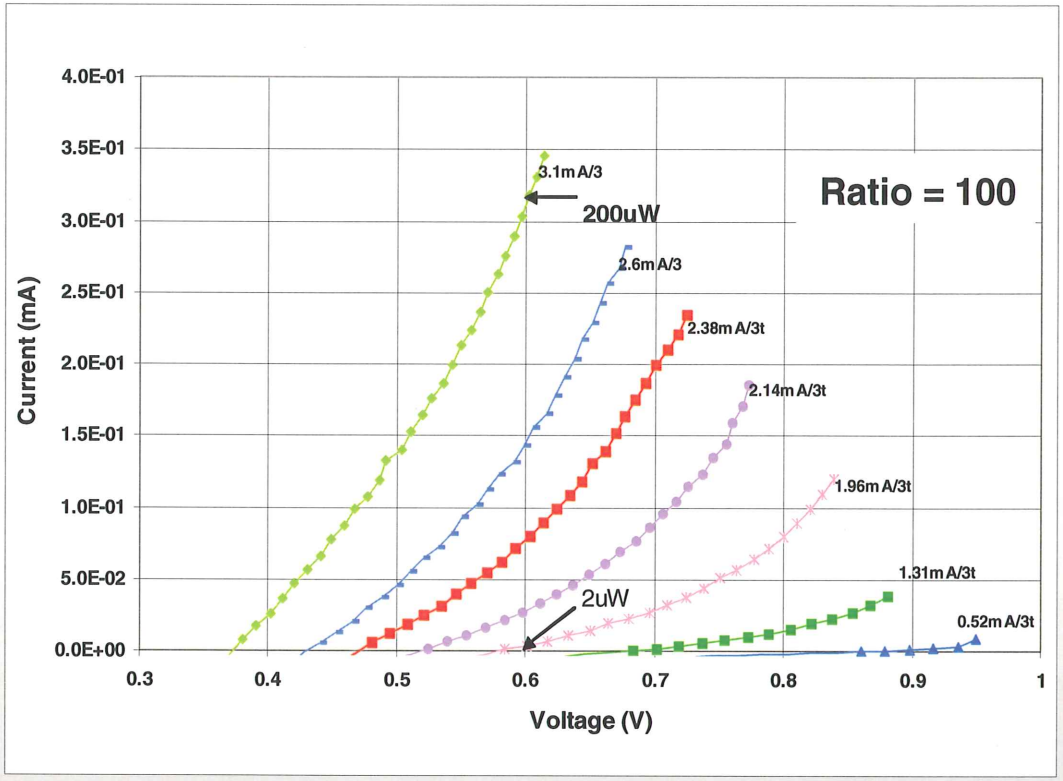
- Our new physics makes new types of all thin-film devices and computers
- Ovonic threshold switch, Ovonic universal memory (phase-change) Ovonic Cognitive Device and now our **Ovonic Quantum Control Device**
- Unique Functionalities – can be used to replace transistors
- Lower cost, higher density of information, circuit simplification by eliminating other conventional devices
- It is a combined digital, analog, extremely fast (never been measured), unique high powered switch
- All in **one** nanostructure device
- Wide modulation of voltage
- Unusual current modulation
- Latching with unusually high gain
- All controlled through a third quantum control electrode
- The conducting current is the highest density solid state plasma by many orders of magnitude, permitting the 50 times current carrying operation compared to a transistor
- Offering many degrees of design freedom with flexibility

The Ovonic Quantum Control Device

Threshold Voltage is Modulated using the Control Terminal

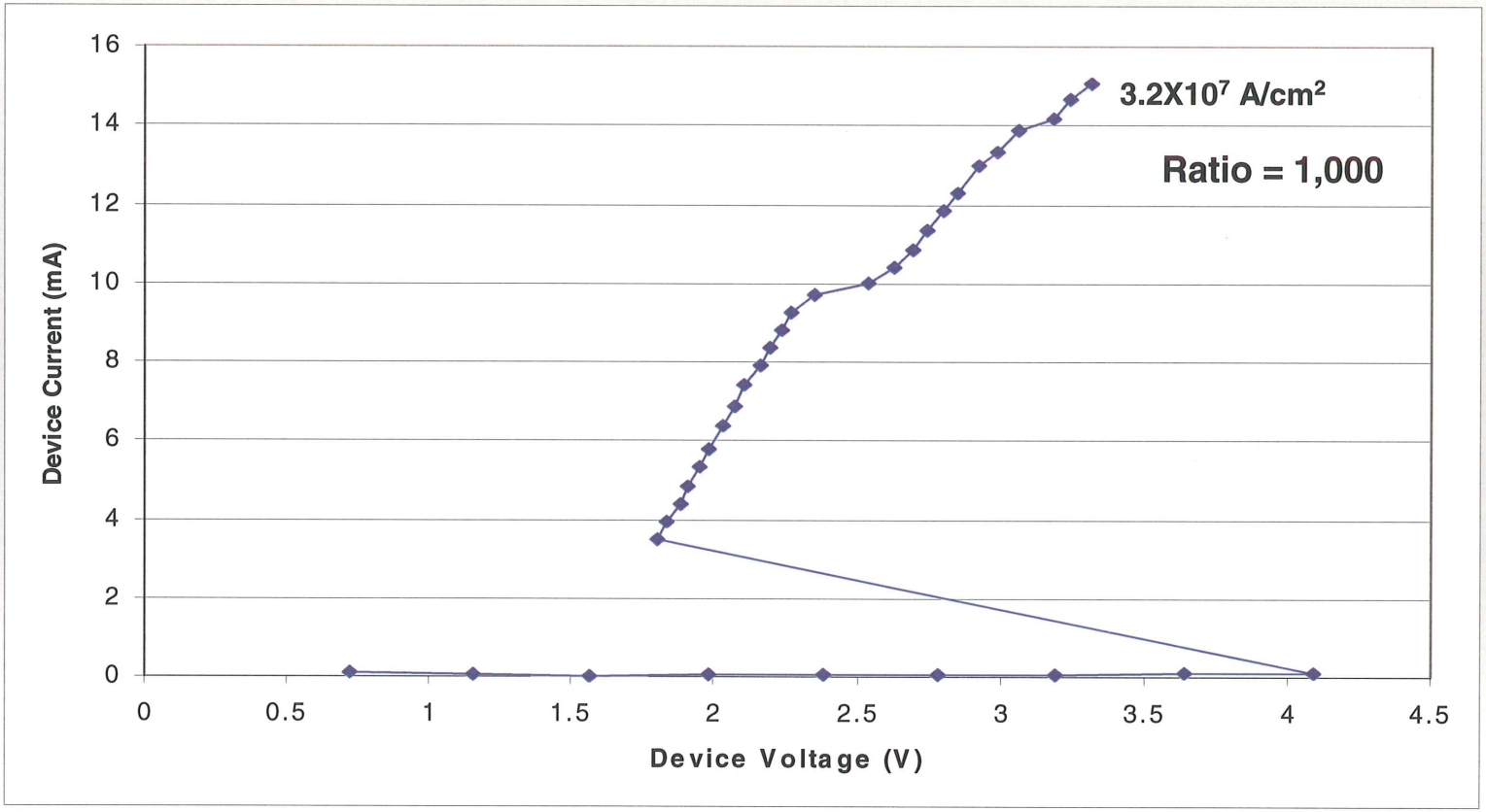
Input-to-Reference Terminal I(V) curves of the OQC device using differing voltages applied to the control terminal.





Both the threshold voltage and the holding current are modulated.

Ovonic Threshold Devices Have Uniquely Very High Current Density Capability



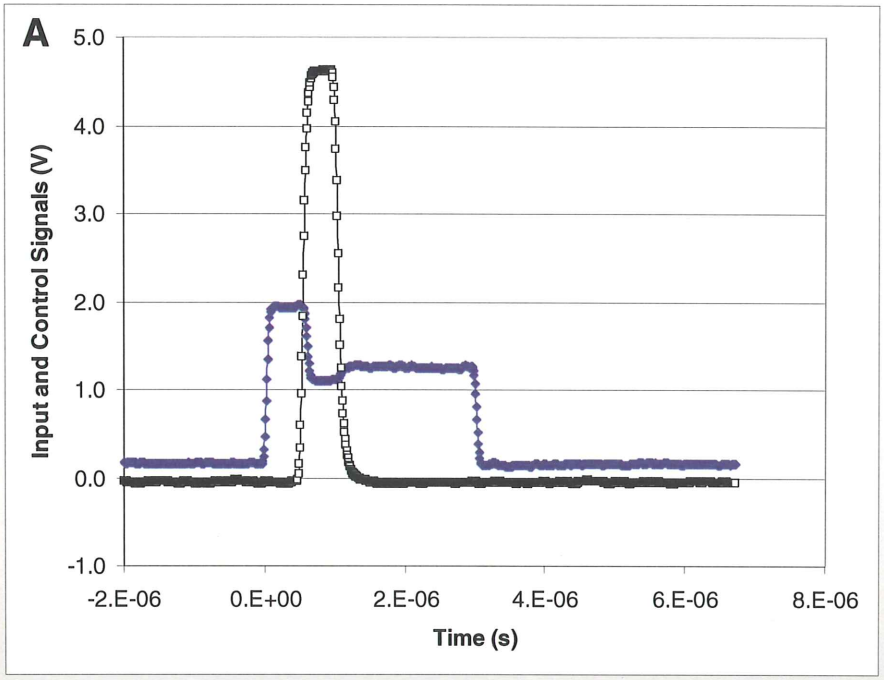
Ovonic Threshold Switches can conduct well over 30 million Amperes per square centimeter, which is 50 times more than the current density capability of bipolar silicon devices.

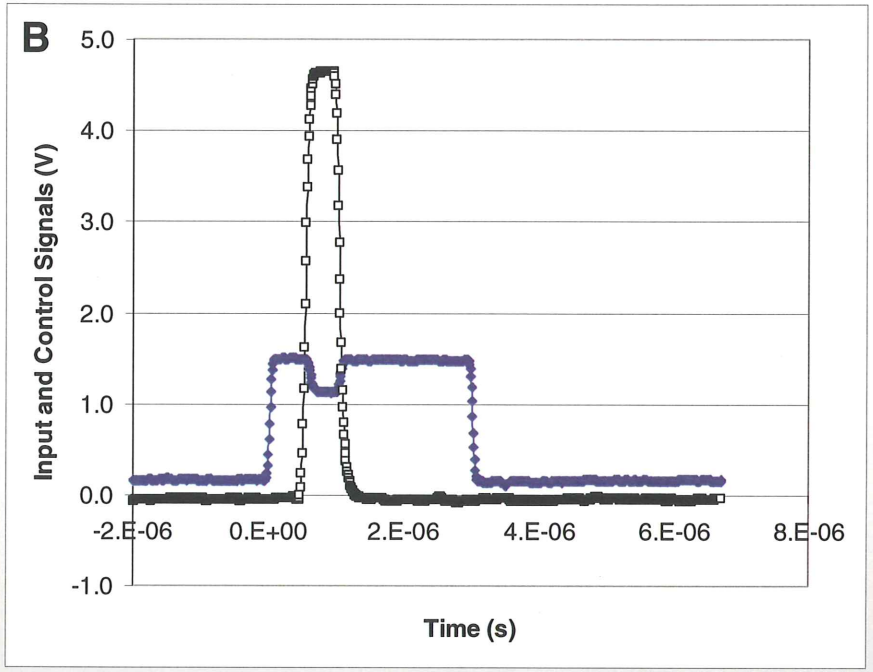
The Ovonic Quantum Control Device

Latching / Non-Latching Operation

The *latching* behavior is demonstrated by the voltage Input-to-Reference staying at the lower holding level after the end of the third terminal pulse.

In the *non-latching* mode the device reverts back to the quiescent state, where the voltage goes from the holding level back up to the applied level. The applied voltage is lower in this case than the latching case to keep the current below the holding level.

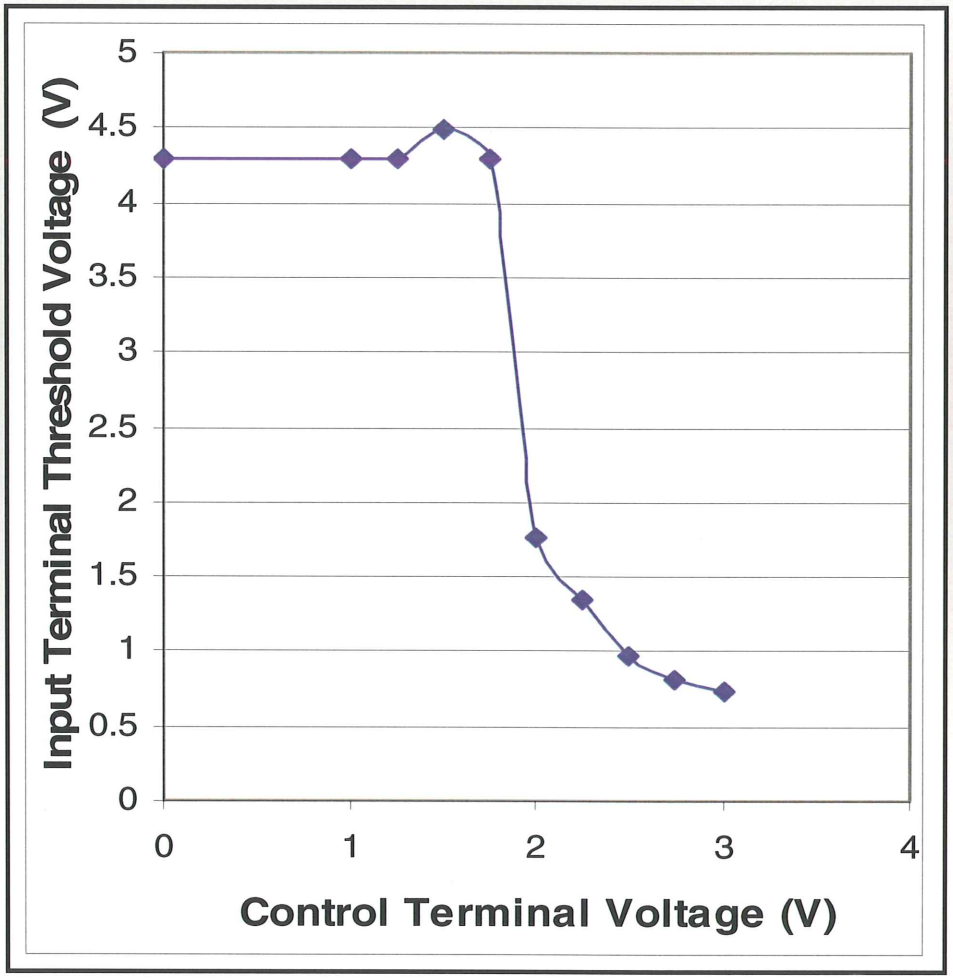




The open symbols show the Control signal and the filled Symbols show Input Terminal signal

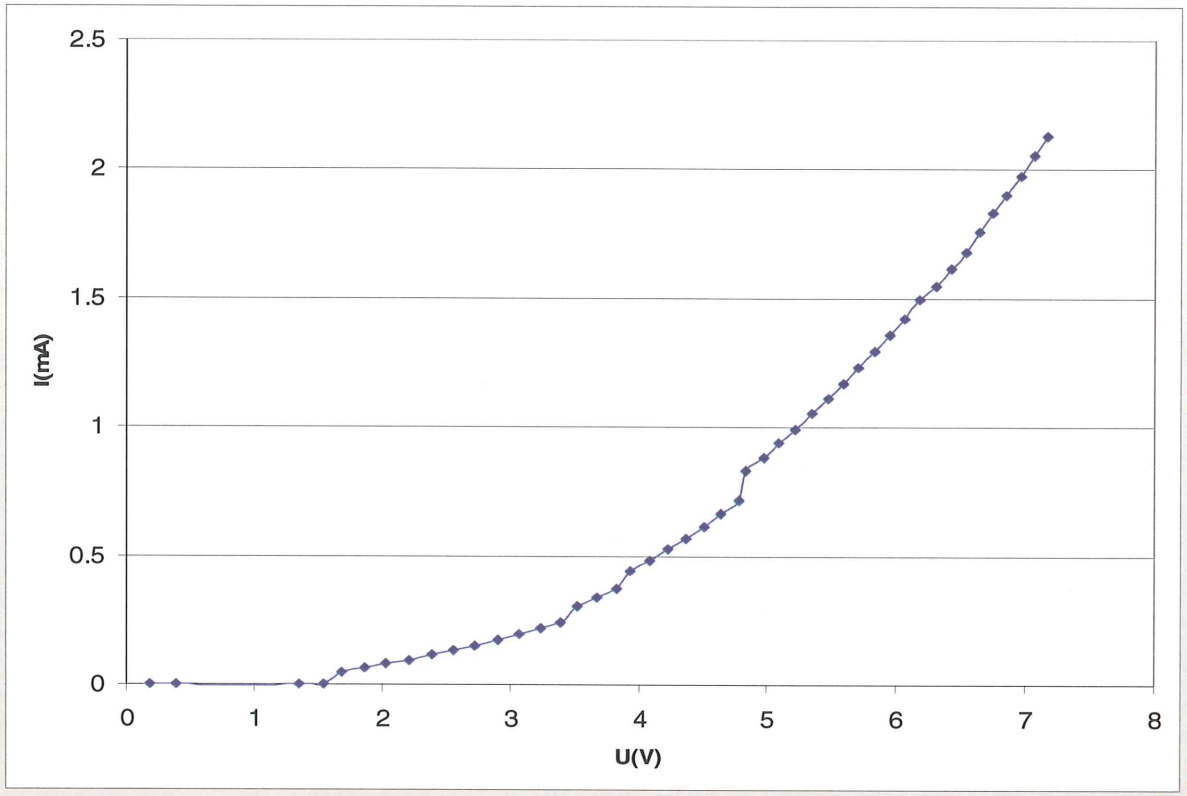
Small energy signal switches large energy

Input Terminal threshold voltage as a function of Control Terminal voltage



Current-Voltage Characteristic of the Ovonic Quantum Control Device Between the Control and Reference Terminals

Quantum effects lead to a smooth transition into the on-state, opening new regions of operation at higher pre-threshold currents



Summary

Ovonics is the bridging physics that envelops all devices

- Ovonic Threshold Switch, Ovonic Universal Memory, Ovonic Cognitive Device, Ovonic Quantum Control Device
- Fundamental Properties
  - Lone Pairs, polymeric structure, plasticity, high current density, scaling
- All devices are made in thin-film form
  - Leads to low-cost, continuous manufacturing
- Follows Ovonic Photovoltaics
  - Nine miles in one run, less than a half micron total thickness, with layers below 100Å, 98% yield, 24/7 operation

Conclusion

The future has arrived!

We can use new science and physics to build a whole new field of control devices on many kinds of substrates.

Entirely new control devices, computers and communication devices will be made!