COMBATING REVERSE ENGINEERING THROUGH TRANSIENCE

Dr. Troy Olsson, DARPA/MTO Program Manager

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The DARPA solution is to provide a menu of hardware security options that can be selectively applied based on need.

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VAPR will help protect intellectual property in DoD microelectronics.
Develop a toolkit that allows for microelectronic systems to vanish in a controlled manner on command.

High performance microsystems that physically disappear resulted from the program.
VAPR vanishing requirements

- Requirements were placed on the vanishing modality to ensure clandestine operations and environmental safety
- Camouflage was not considered vanishing

- **Loud Noises**
  - U.S. Forest and Wildlife Service (USFWS)

- **Smoke or Fire**
  - USFWS, Credit Catherine Hibbard

- **Incendiary Chemicals**
  - Wikipedia/Creative Commons

- **Toxic Remnants**
  - Maine Government

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VAPR transient glass substrate

Prince Rupert’s drop
- Formed by rapidly cooling molten glass
- Compressive stress on the surface and tensile stress at the core
- Stress gradient results in high toughness
- Surface damage results in rapid disintegration into fine particles

PARC’s transient substrate
- Stress gradient formed by ion exchange of glass
- Similar to Gorilla Glass process
- Highly controlled stress profile
VAPR glass substrate demonstration

Demo: Trigger initiates rapid heating and cooling above resistor to initiate crack formation

Demo: Robustness during handling and storage

Extremely **Reliable and Stable** until Triggered to Vanish!
VAPR glass substrate fragmentation

Time Evolution of Fracture

0 ms

0.13 ms

0.20 ms

0.96 ms

3.24 ms

10.07 ms

(U) 0.25 mA hr, peak current of 1 A

Video not included here

Image Courtesy: PARC
VAPR functional vanishing chips

- Enhanced security through vanishing electronics
- Strain energy transferred from PARC substrate to COTs chips
- Fragmentation of ICs and substrates to particle sizes < 250 μm
- Goal to achieve no visible remnants after triggering

Image Courtesies: PARC
• DARPA VAPR Program has demonstrated a frangible glass substrate that can fracture into < 250 μm particle upon triggering

• Robust handling and storage of the frangible glass has been shown

• Fracture propagation through diverse set of chips has been demonstrated

• Functional devices have been produced that demonstrate use of COTS devices, these devices can monitor temperature and receive RF signals