# Progress & Future
# Super-Resolution Near-Field Structure
# Super-RENS Optical Data Storage

National Institute of Advanced Industrial Science & Technology
AIST
Center for Applied Near-Field Optics Research
CAN-FOR

Junji Tominaga

# What's next?

- Multi-layer recording: double, triple,....
- Holographic memory
- 2-photon 3D optical memory
- Near-field recording

# Near-Field Optical Recording

- Fiber probe recording and readout
- Solid immersion lens
- Super-resolution near-field structure, Super-RENS

Only these two technologies performed the technical proof beyond the capacity and data transfer rate of blu-ray at a spin-stand drive at this moment.

# Super Resolution Near-Field Structure

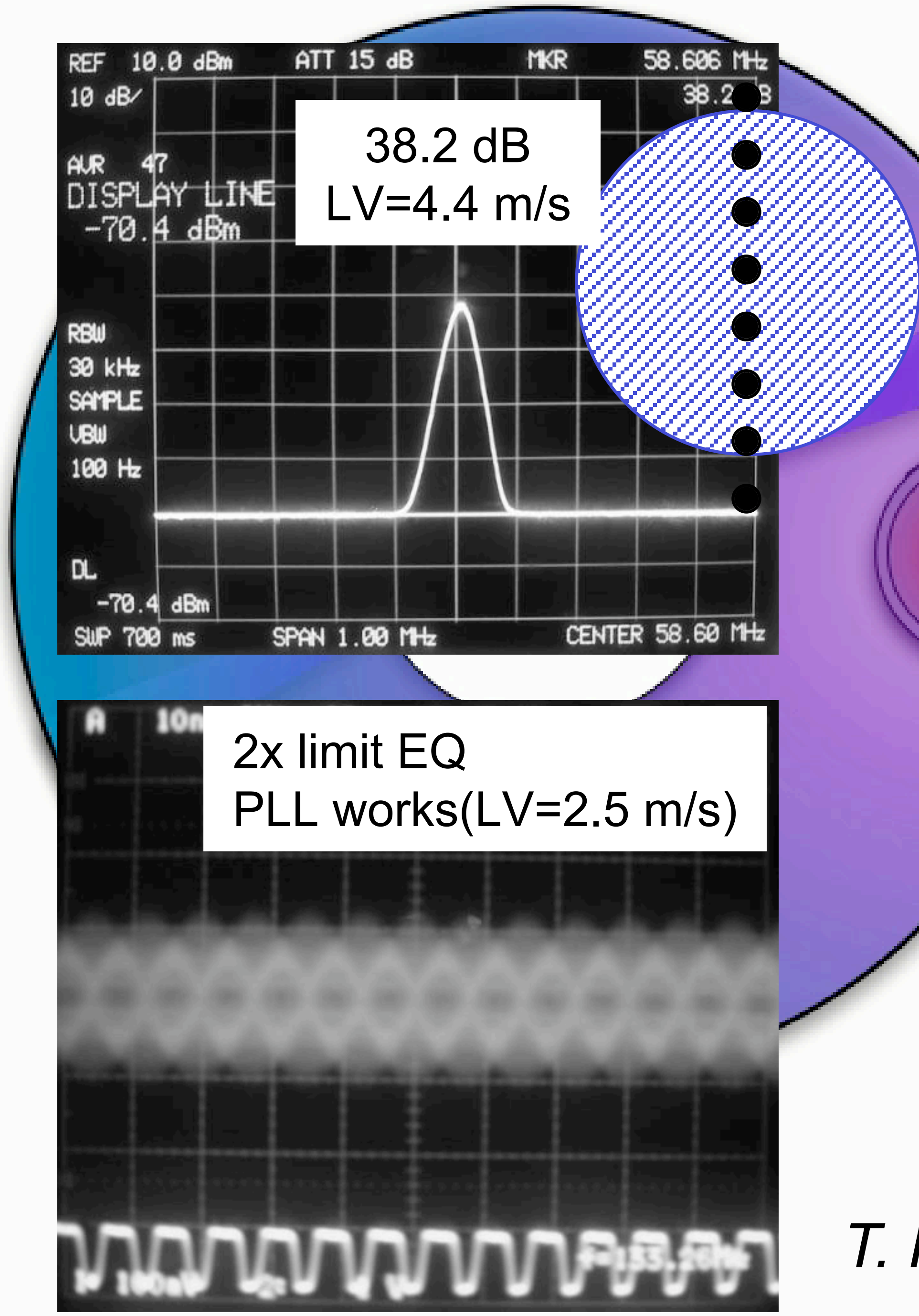
Super Resolution near-field structure, super-RENS was invented for an objective to realize ultra-high density optical data storage by near-field optics in 1998.

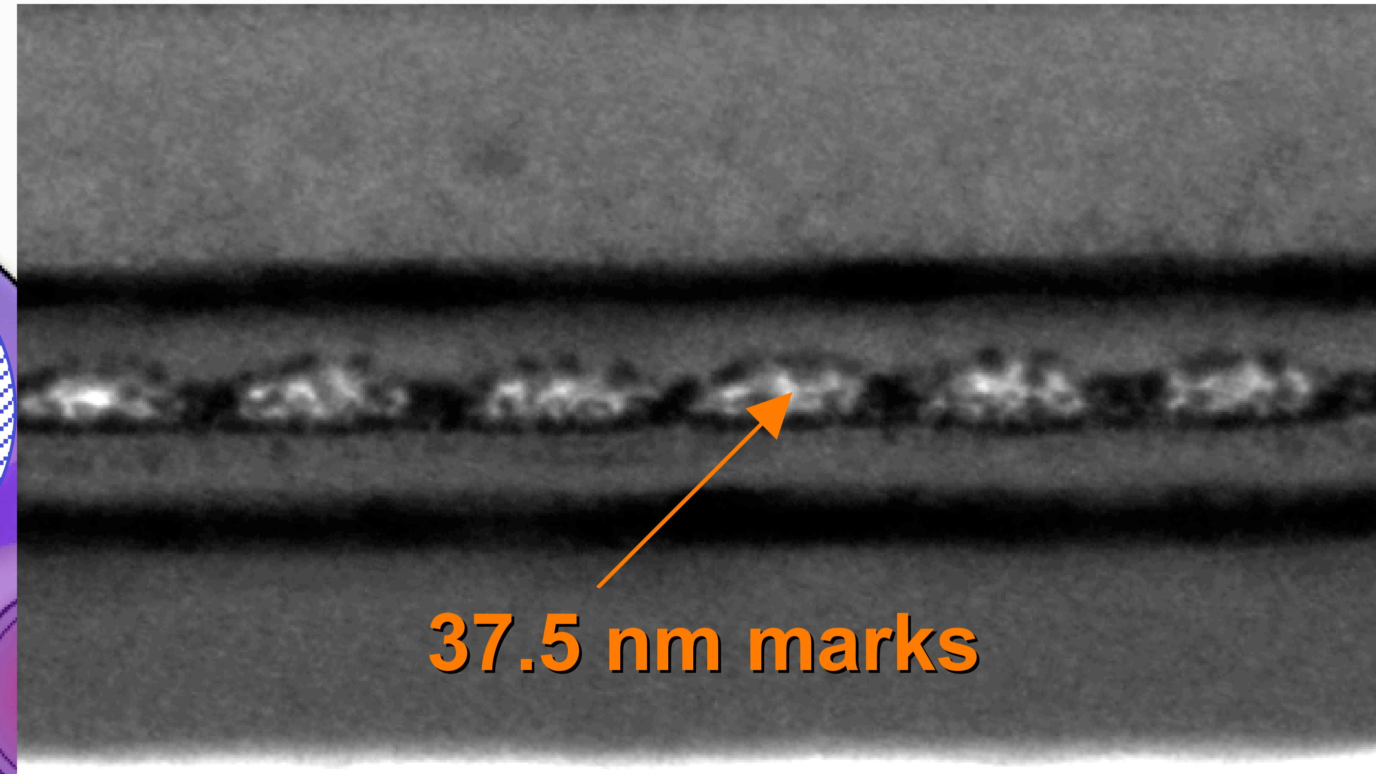
The innovation is to replace air-space control with a solid thin layer sandwiched between recording and near-field source.

J. Tominaga, T. Nakano and N. Atoda, “An approach for recording and readout beyond the diffraction limit with an Sb thin film,” Apppl. Phys. lett. 73, 2078-2081 (1998)

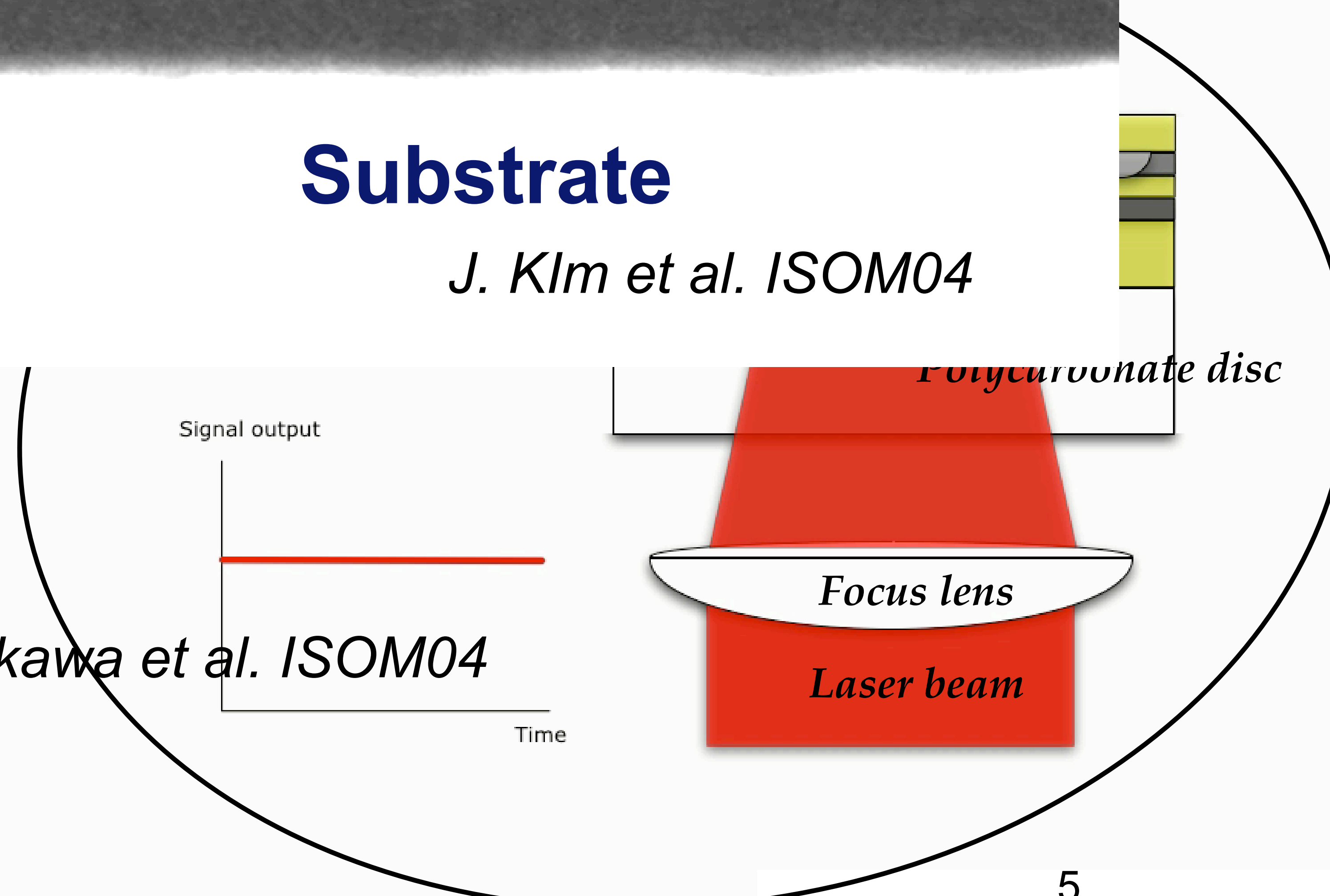
*PtOx bubble pit type super-RENS disc*

# *Super-RENS -The principle-*



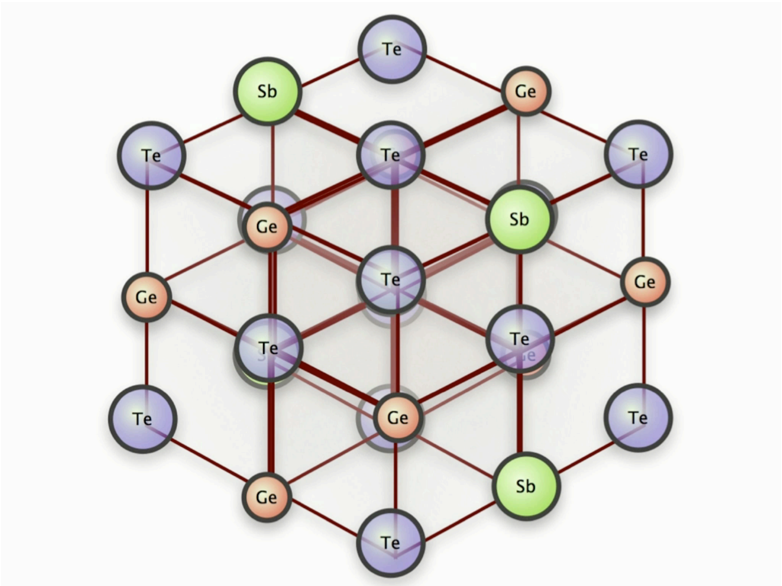

J. KIm et al. ISOM04




T. Kikukawa et al. ISOM04

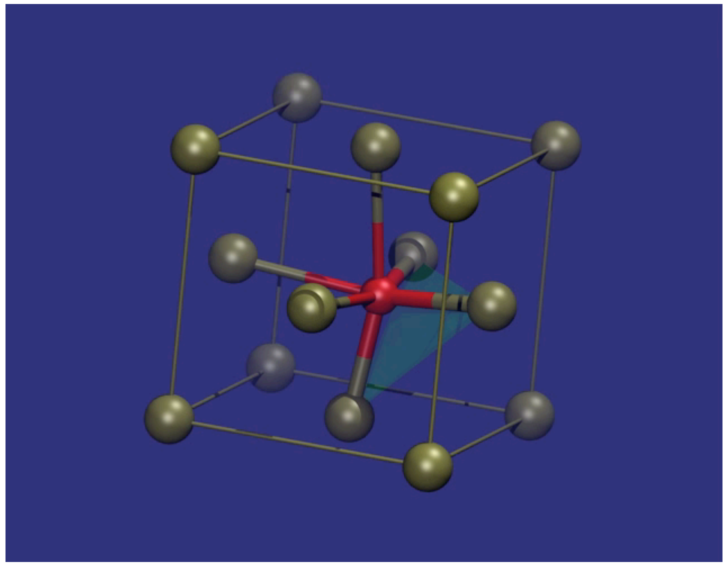
Error rate < $6x10^{-4}$

# Understanding PC mechanism and nanoswitching




In 2004, we provided a new model to understand the fast switching between amorphous and crystal in $Ge_2Sb_2Te_5$.

A. Kolobov, P. Fons, A. Frenkel, A. Ankudinov, J. Tominaga, and T. Uruga, *Nature Materials* **3**, 703 (2004).



In Kolobov model, Te, Sb and Ge atoms are not randomly coordinated at a-site and b-site in a rock salt lattice.

Ge has 6 coordination number by 3-long bonds and 3-short bonds with adjacent Te atoms in crystal.

Ge has 4 coordination number by 4-short bonds in amorphous.

The Ge coordination change is the mechanism of the phase transition.

# What does this model mean?

- Ultimate resolution and switching size in PC is less than 10 nm!
- According to the simple mechanism in switching, many readout and durability are ensured.

Super-RENS disc can be further improved by 10~20-nm resolution from 30 nm.