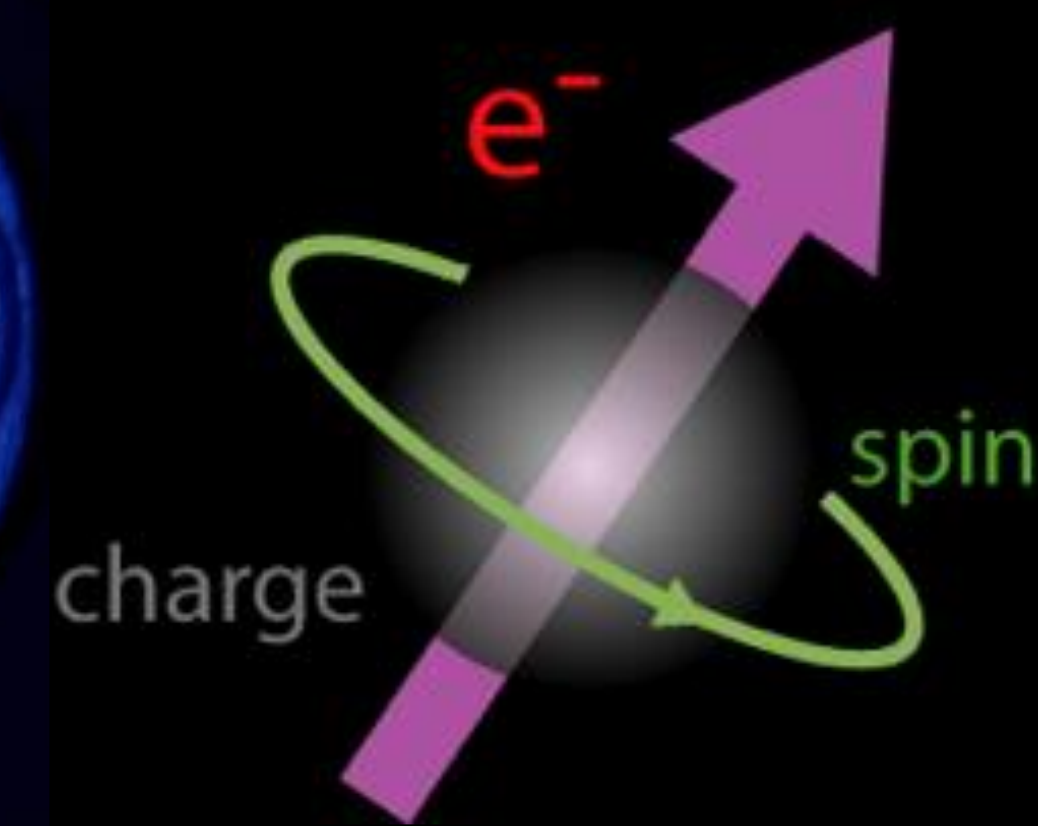


# MULTIBIT STORAGE DEVICES

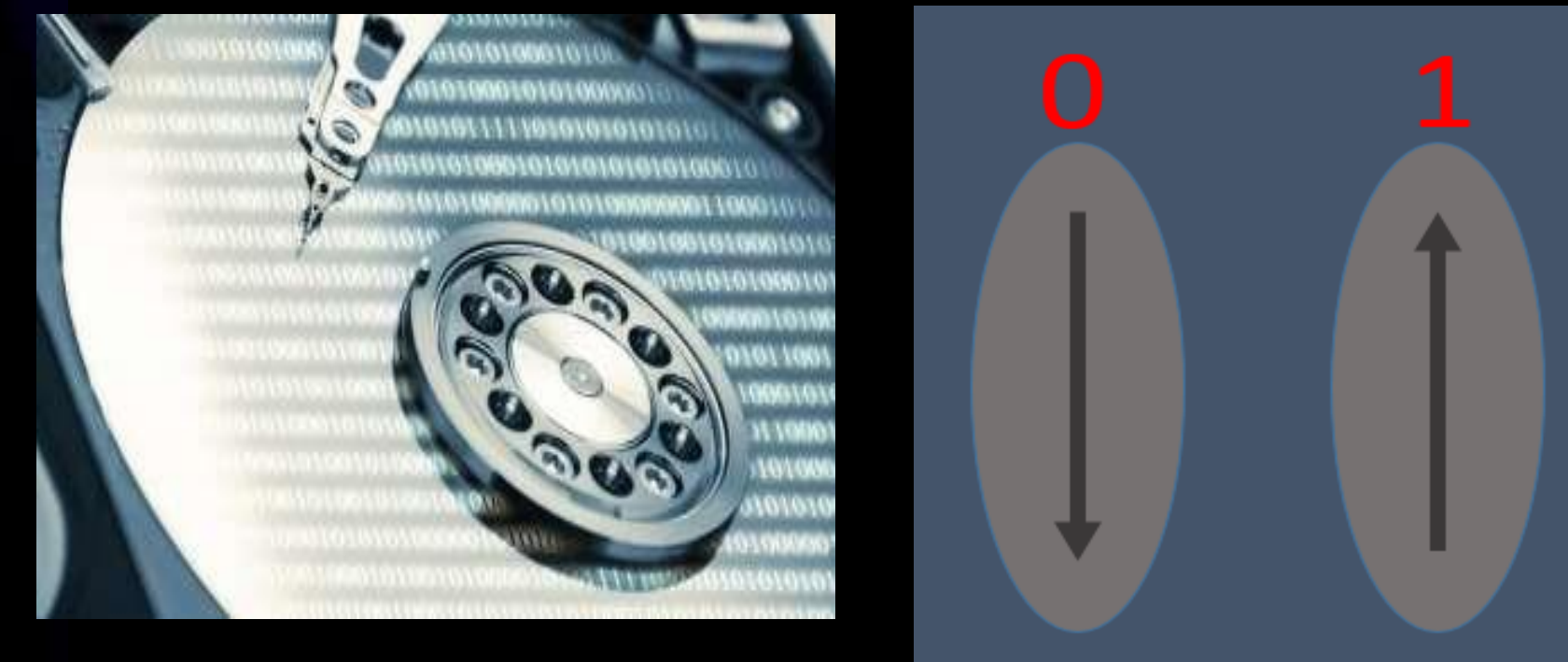
Shaik Wasef , Selma Amara , Meshal Alawein and Hossein Fariborzi

Integrated circuits and systems group  
Computer , Electrical and Mathematical Sciences and Engineering Division  
King Abdullah University of Science and Technology , Thuwal , KSA

جامعة الملك عبد الله  
للعلوم والتقنية  
King Abdullah University of  
Science and Technology



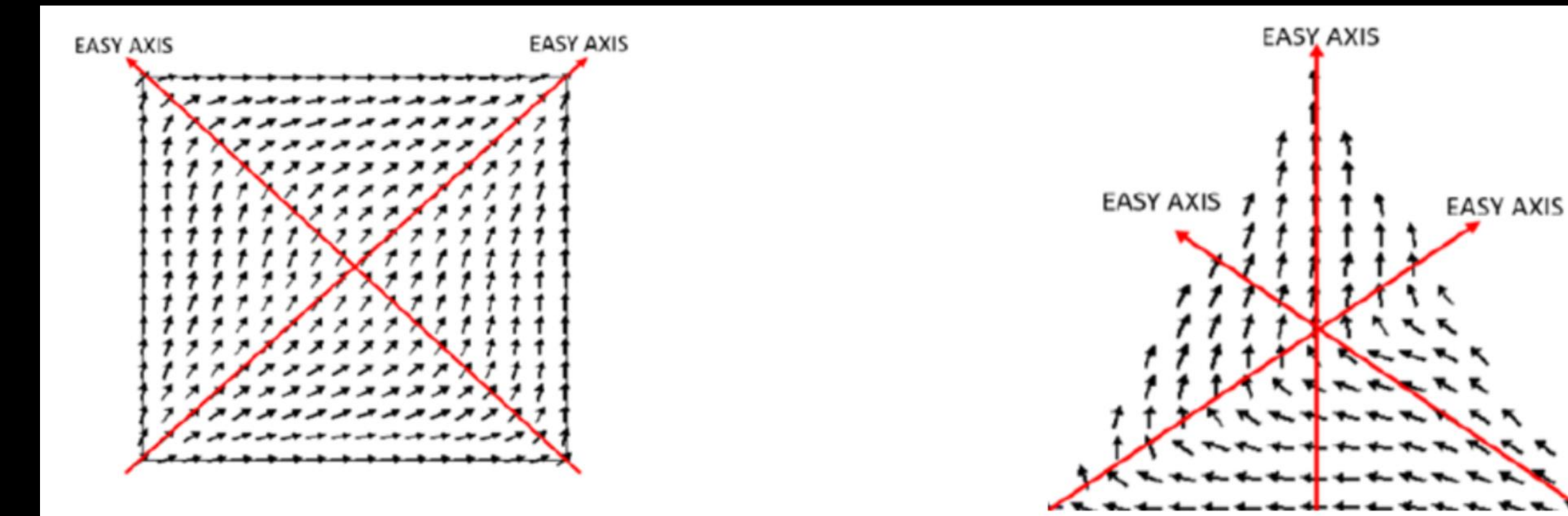
- Memory is stored in the form of alignment of spins in a ferromagnet.



- Sizing the structures is limited by superparamagnetism .
- Increasing the memory density is a challenge .

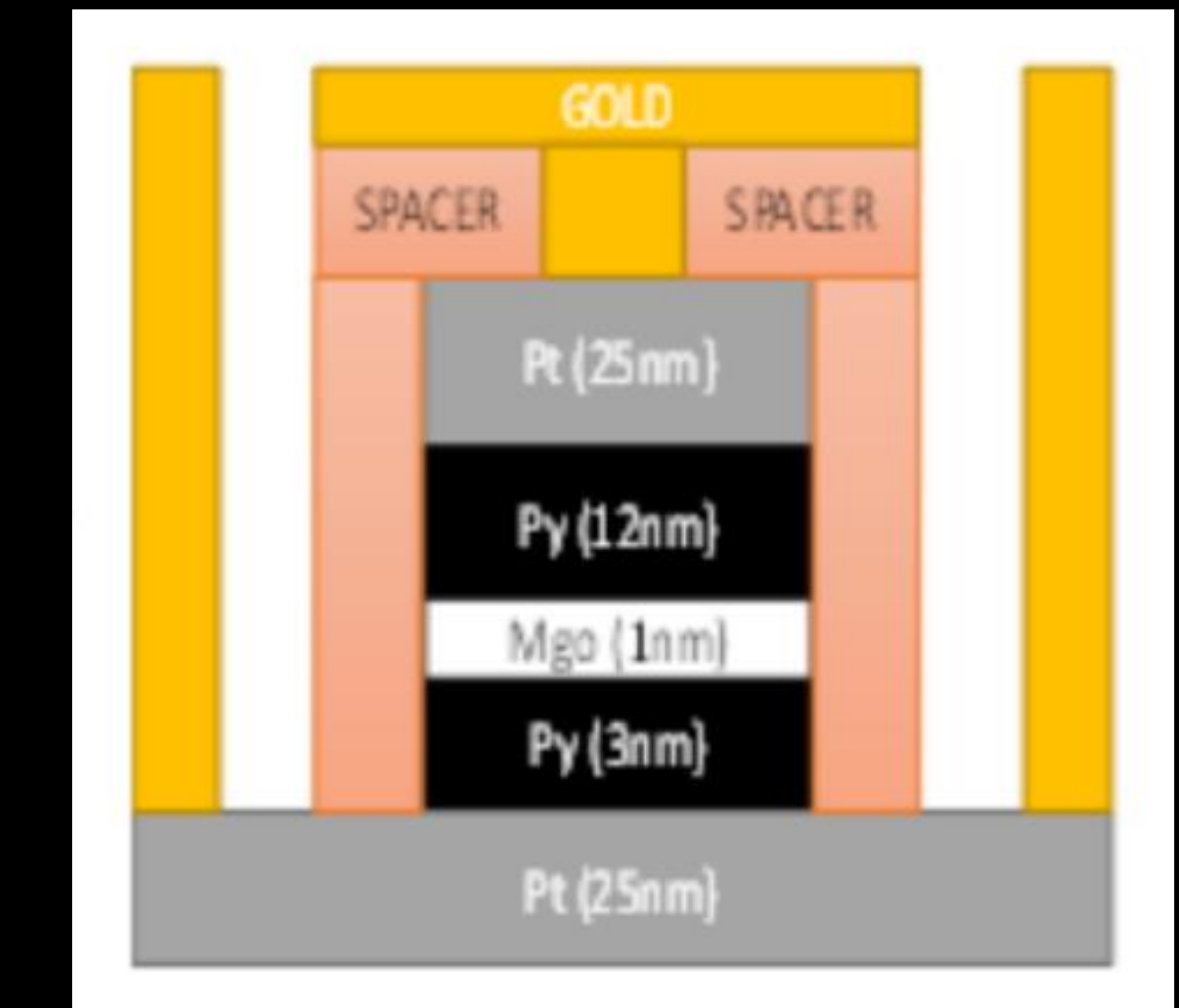


- Solution is to increase the number of easy axis in the structure by introducing magnets of different shapes like a square or a triangle .

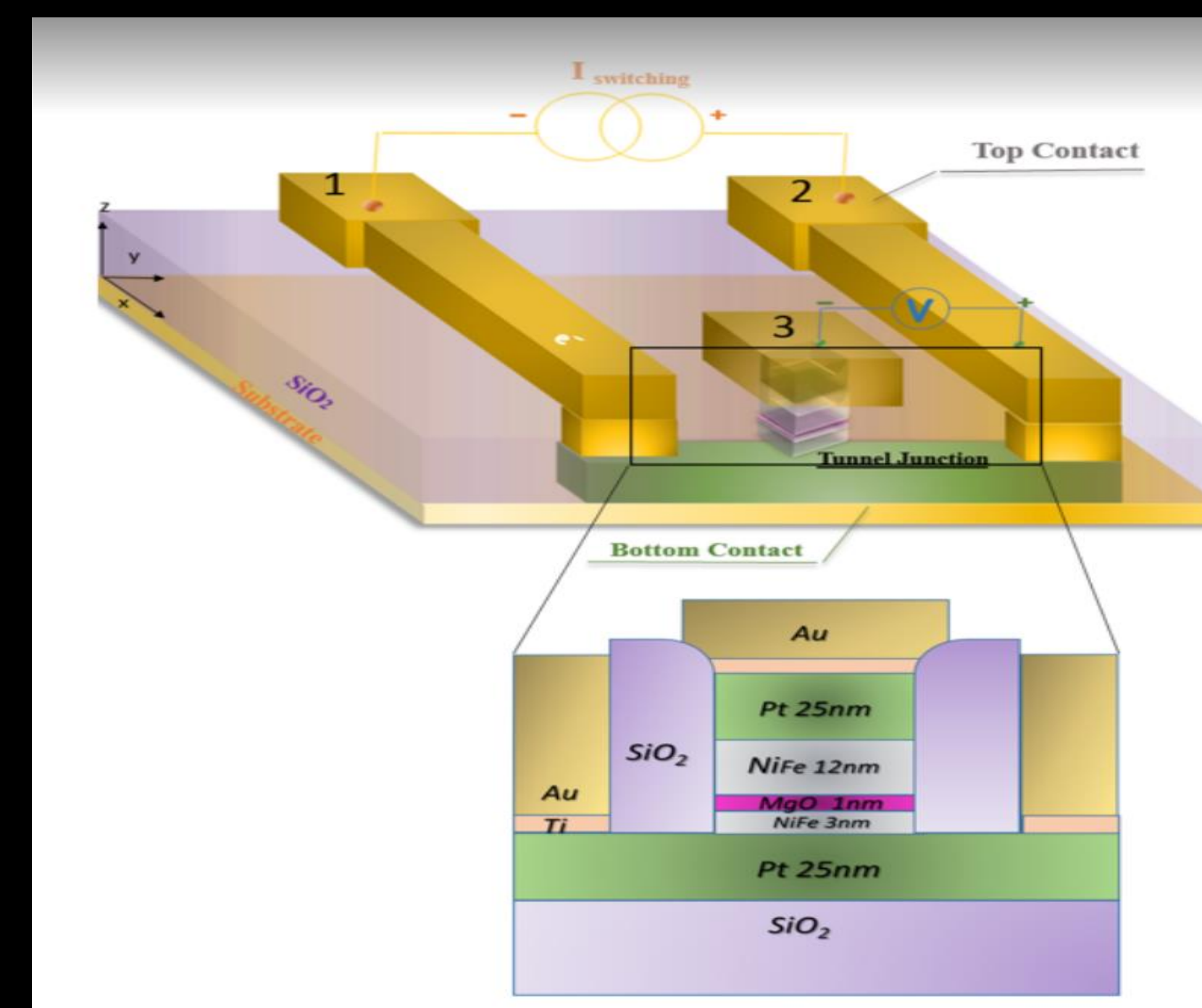


- A square has two easy axes and a triangle has three easy axes.

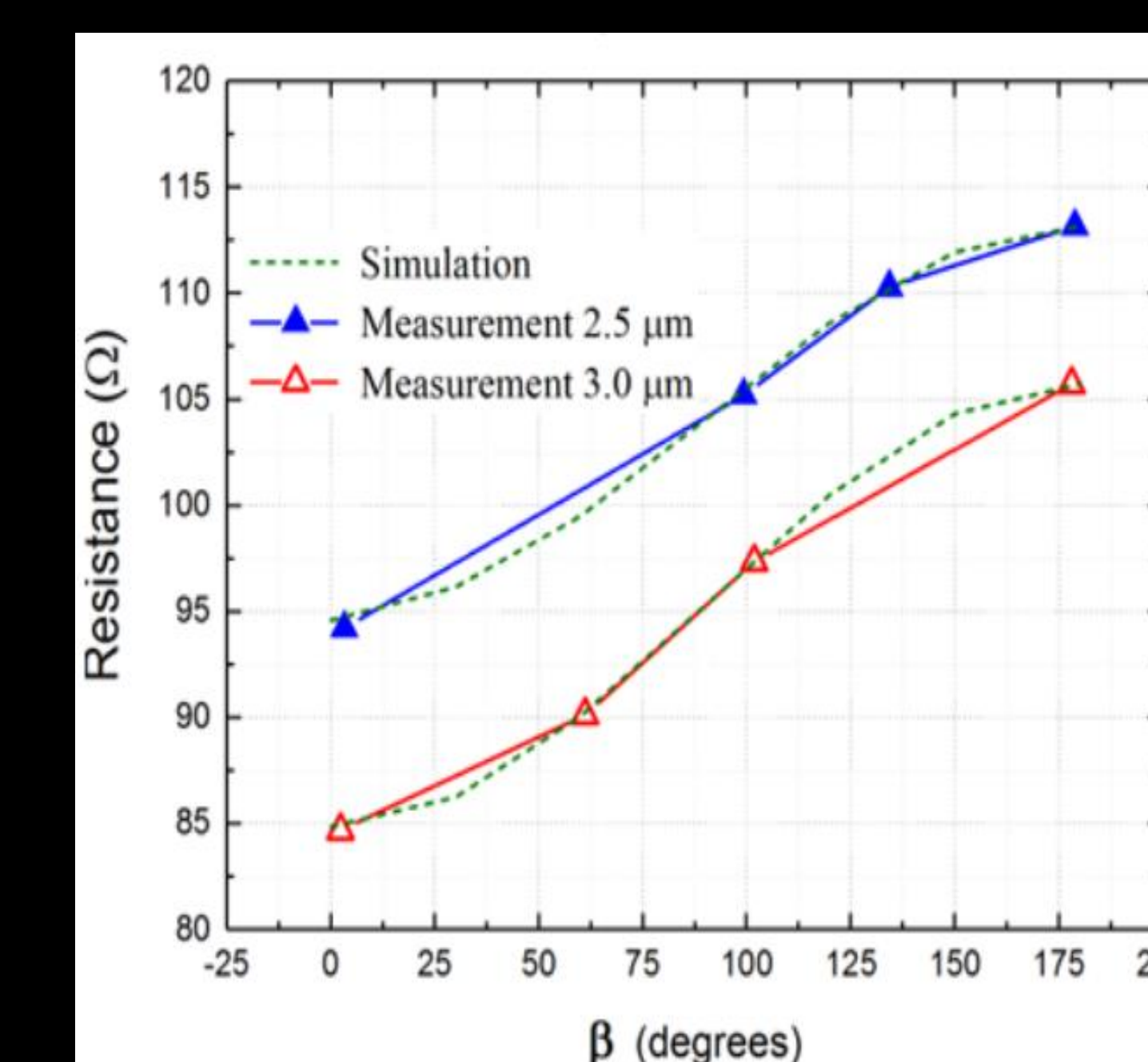
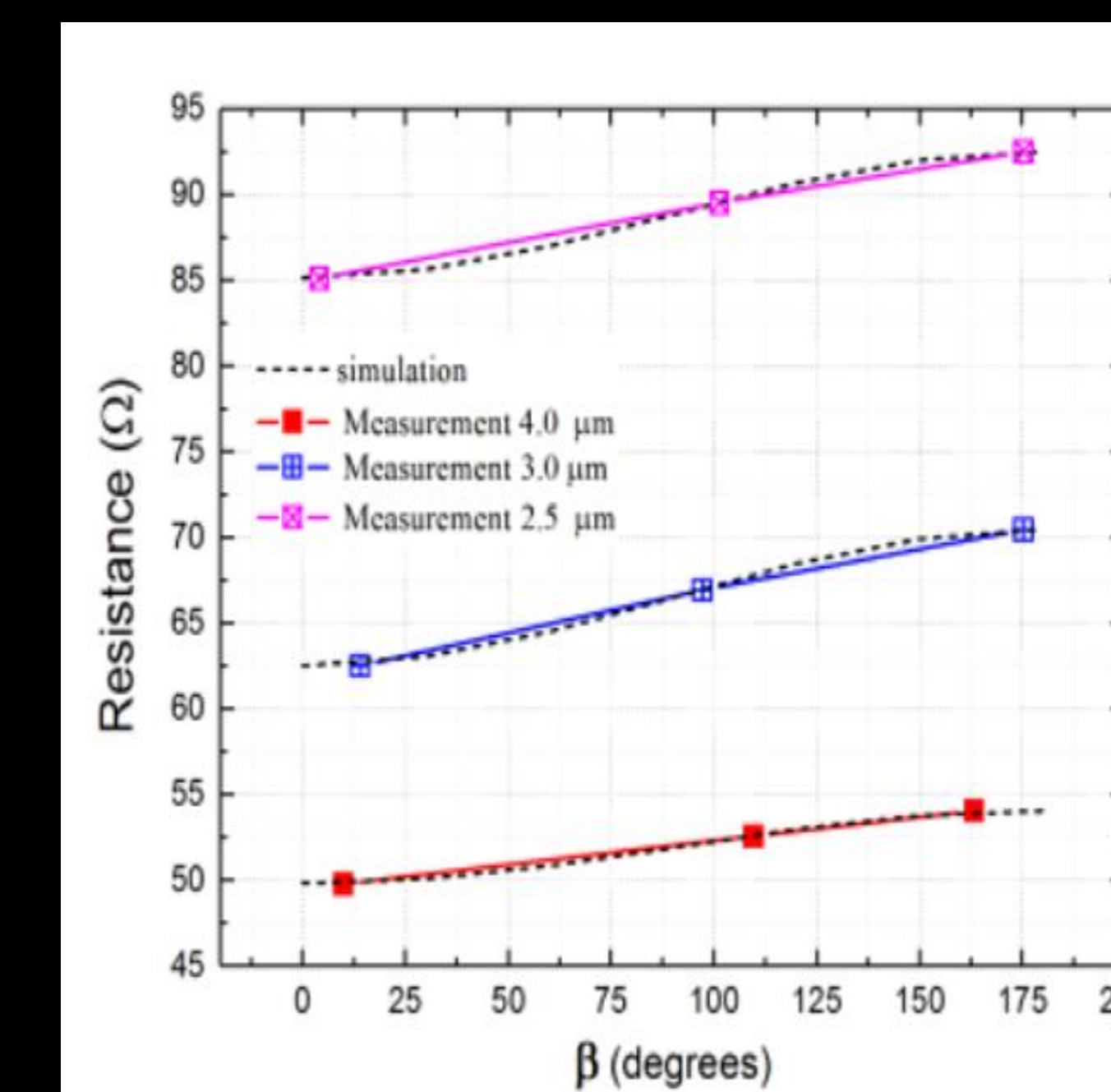
- The MTJ stack we fabricated Platinum(25nm) / Py(3nm) / MgO(1nm) / Py (12nm) / Pt (25nm) .



- The writing current is 20mA applied between contact 1 and contact 2.
- The current switches the magnetization along the easy axes in the free layer Py(3nm) due to spin hall effect .
- For reading a current of 14uA is used between contact 2 and contact 3.



- The graphs represent the existence of 4 states in a square structure and 6 states in a triangular structure .



## References

[1] S. Wasef, S. Amara , M. Alawein , H. Fariborzi , submitted to Electronic devices technology and manufacturing (EDTM) – 2018 , Kobe, Japan.