Electrically Operated van der Waals Magnon Circuits

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The plurality of spin structures and relatively weak interlayer interactions in van der Waals magnets have provided a fertile playground for low-dimensional spin excitation and spin-based device applications. Here we demonstrate complete electrical on-off switching of the second harmonic magnon signal on van der Waals antiferromagnetic insulator MnPS3, as well as giant electrical tuning of in-plane magnon transport anisotropy in low-symmetry van der Waals antiferromagnetic insulator CrPS4. Based on the above tunability, we demonstrated electrically-controlled magnon-based digital inverters and read-only memories. These results unveil the potential of van der Waals anti-ferromagnets for studying highly tunable spin-wave physics and for application in magnon-base circuitry in future information technology.

References

[1] Guangyi Chen *et al.*,"Electrically Switchable van der Waals Magnon Valves", Nature Communications 12:6279 (2021)
[2] Shaomian Qi *et al.*,"Giant electrically tunable magnon transport anisotropy in a van der Waals antiferromagnetic insulator", Nature Communications 14: 2526 (2023)

Figures

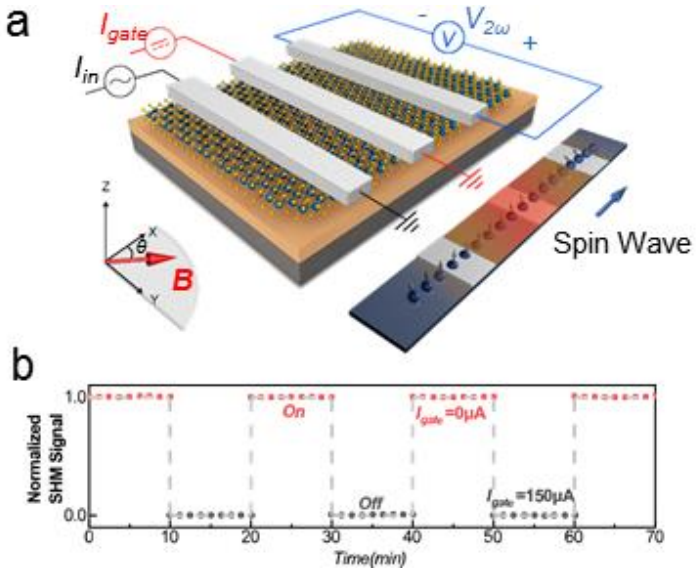

Figure 1: a. Schematics of the van der Waals magnon valve; b. Electrical switching operation of a magnon NOT gate.

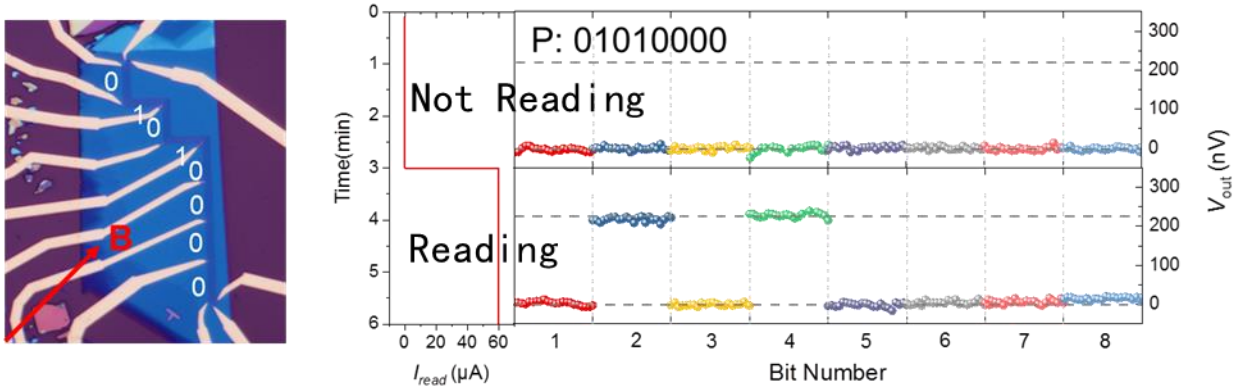

Figure 2: Optical micrograph and operation of anisotropic magnon read-only memories.