Supporting Information:

Giant Tunnelling Electroresistance through 2D Sliding Ferroelectric Materials

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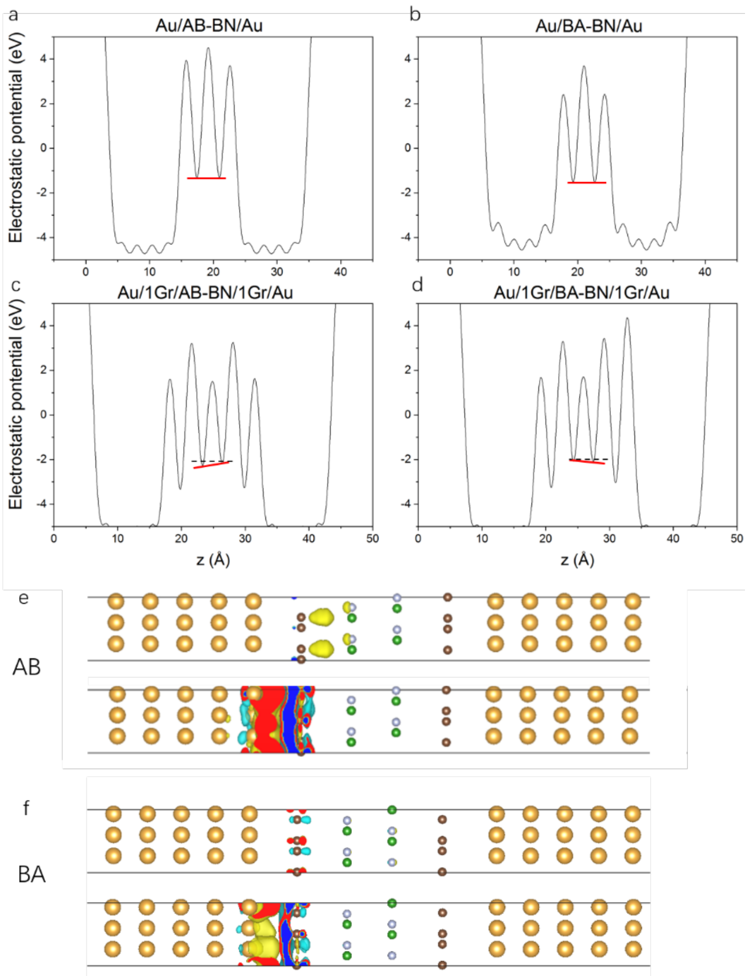


Figure S1. Planar averaged macroscopic electrostatic potential in the *AB*-stack configurations without (a) and with (c) monolayer graphene. (b) and (d) are the same with (a) and (c) but for the *BA*-stack configurations. The red lines connect the potentials of two BN layers. Charge density difference in graphene/BN interface and Au/graphene interface for the *AB*- (e) and *BA*-stack (f) cases.

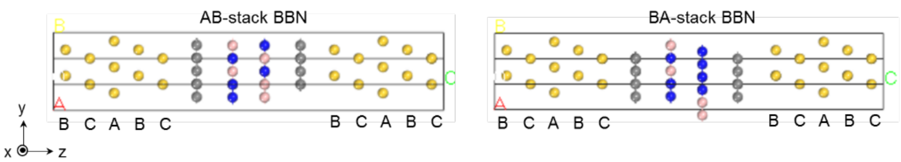


Figure S2. *yz* plane side views of graphene intercalated device configuration of bilayer *h*-BN with AB and BA arrangements. Two Au (111) electrodes are mirror asymmetric.

It's worth mentioning that the I-V curve is nonlinear for the Au/BBN/Au FTJs because of the Schottky-type Au/BBN interface. The linear I-V curve shown in **Fig. 2a** in the main text only occurs under small bias. As the bias continuously increases, the output will show a typical Schottky-type character (**Fig. S2**). Notice that tThe current differences among the *AA*-, *AB*-, and *BA*-stack FTJs are still very small under a big bias of 5 V.

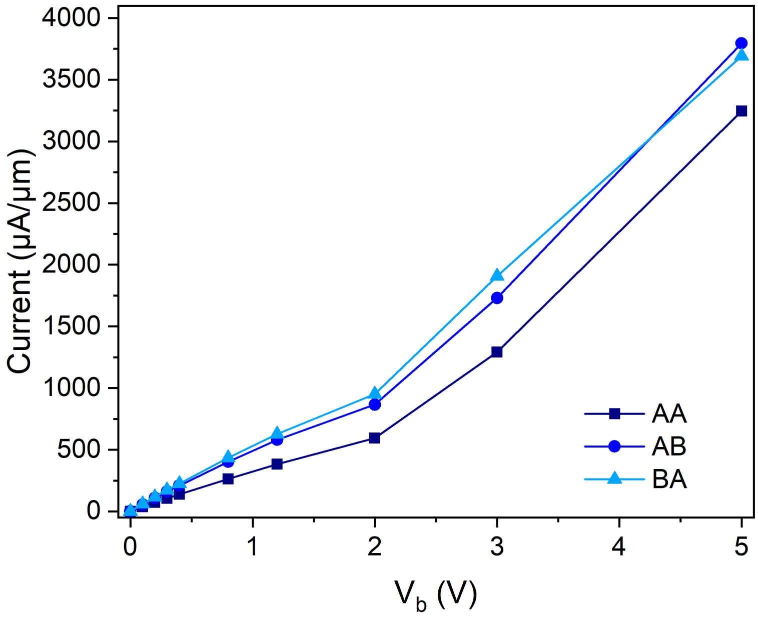


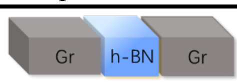
Figure S3. I-V output of the Au/BBN/Au ferroelectric tunnel junctions with different stack types.

Table S1. Summary of work functions of *M* (*M* = Au, Au/Gr), ΔV, E_v, Φ_p^W, and Φ_p^{QT} in eV. Φ_p^W and Φ_p^{QT} is the Schottky barrier height calculated by the work-function approximation and quantum transport calculation.

M	W_M	$W_{M\|BN}$	ΔV	E_v	Φ_p^W	Φ_p^{QT}
Au	5.58[a]	4.92[a]	0.70	6.04[a]	1.12[a]	1.50
Au/Gr	4.80[b]	4.94	-0.14	6.04[a]	1.10	1.70

[a]Reference;[1] [b]Reference.[2]

Table S2. Conductance of BBN SFTJs with different electrodes.

	Au electrode	Graphite electrode
Device model		
G_{AB} (e^2/h)	3.83×10^{-3}	1.62×10^{-7}
G_{BA} (e^2/h)	4.13×10^{-3}	4.00×10^{-7}

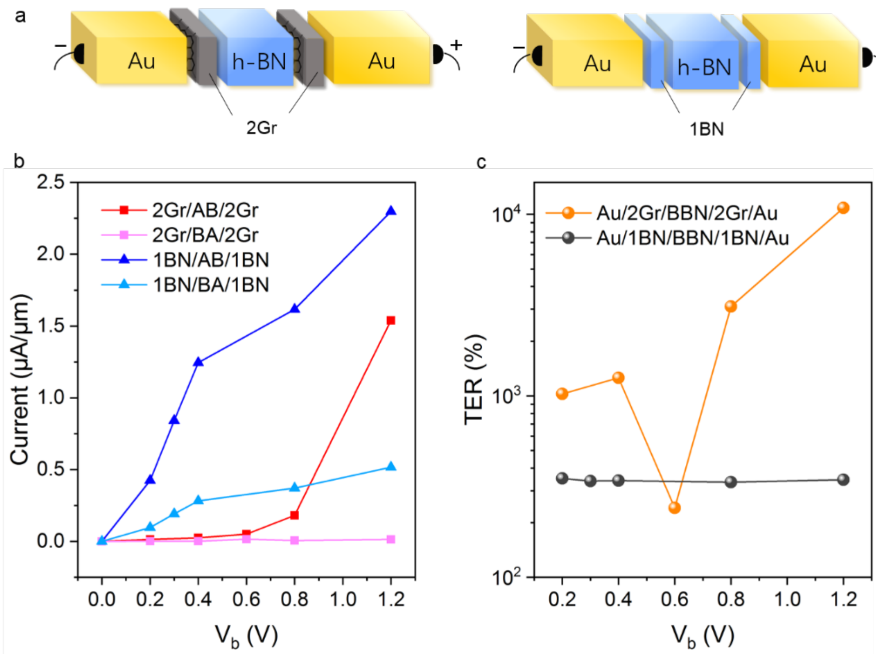


Figure S4. (a) BBN sliding ferroelectric tunnel junctions with bilayer graphene and monolayer BN intercalation. (b-c) IV output and TER of the Au/2Gr/*h*-BN/2Gr/Au and Au/1BN/*h*-BN/1BN/Au ferroelectric tunnel junctions with different stack types.

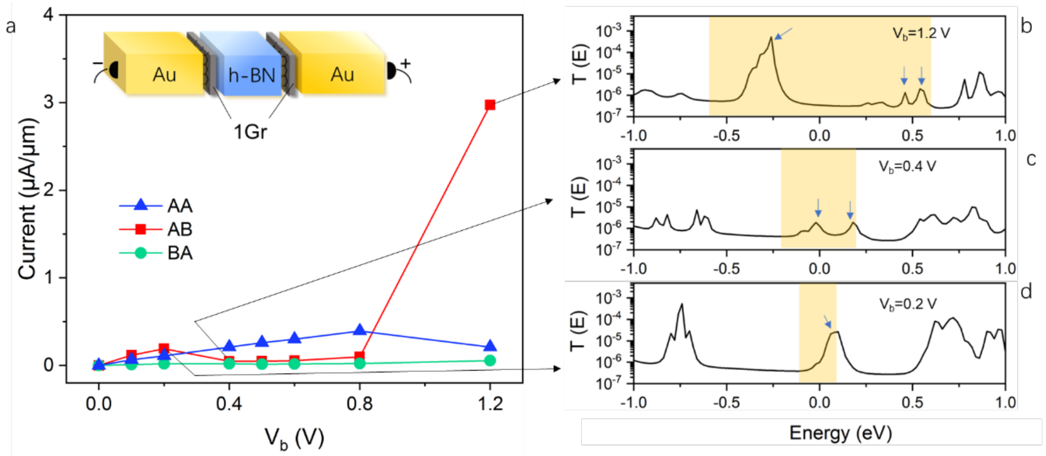


Figure S5. (a) I-V outputs of bilayer *h*-BN ferroelectric tunnel junctions with monolayer graphene intercalation (Au/1Gr/BBN/1Gr/Au). (b-c) Transmission spectra of Au/1Gr/BBN/1Gr/Au FTJs in AB stacking under a bias of 1.2, 0.4, and 0.2 V, respectively. The yellow zone represents the size of the bias window. The blue arrows in the bias window point to main transmission peaks that contribute to the total current.

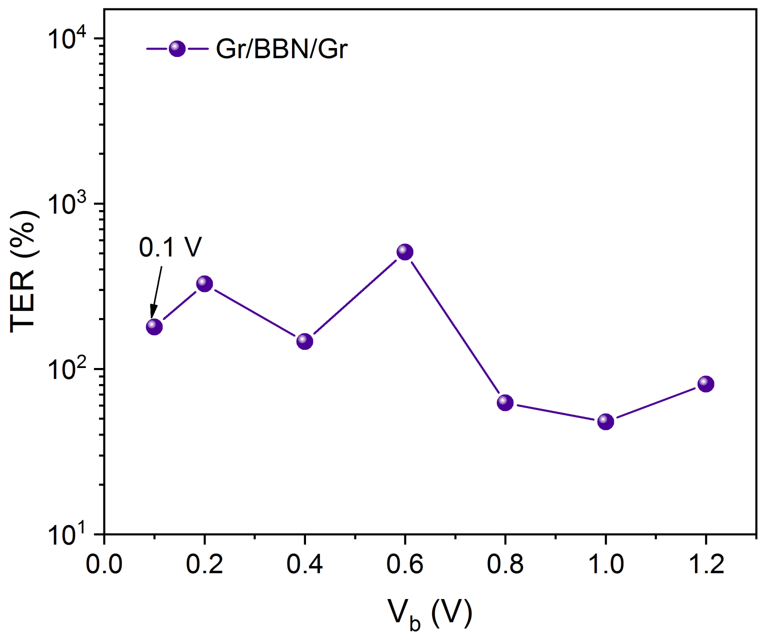


Figure S6. IV output (a) and TER (b) of the BBN sliding ferroelectric tunnel junctions with pure graphite electrodes.

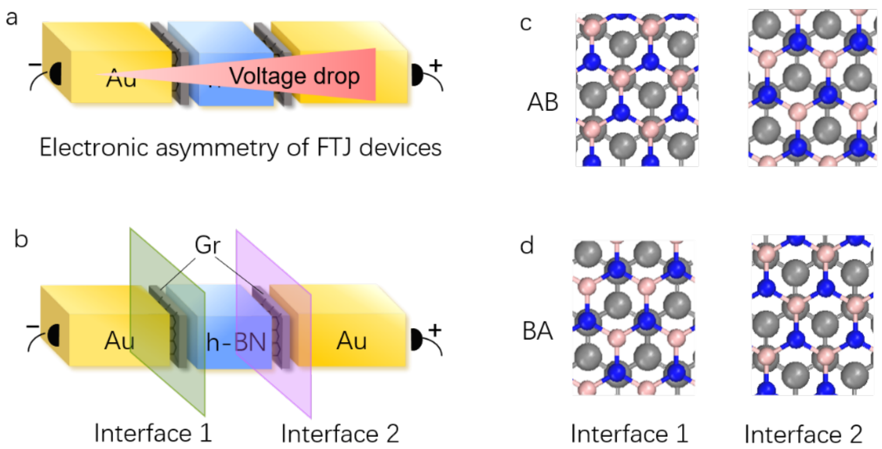


Figure S7. (a) Electronic asymmetric FTJs with bias. (b-d) Two Gr/BN interfaces in the AB-(c) and BA-stack (d) Au/Gr/BBN/Gr/Au FTJs.

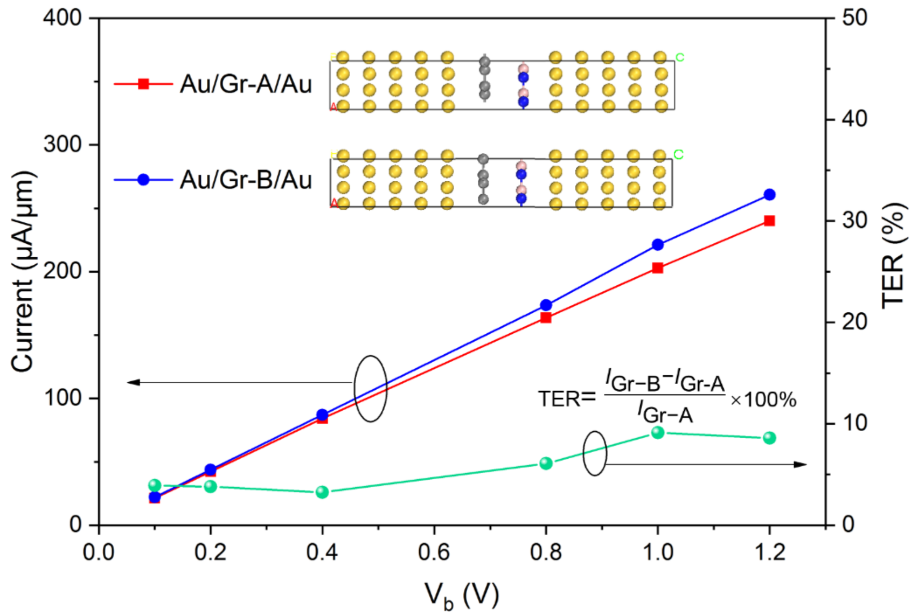


Figure S8. IV-curves and TER induced by the contact displacement (see the two in-plane geometries of Gr/BN in Figure S6c) in the Au/1Gr/1BN/Au tunnel junctions.

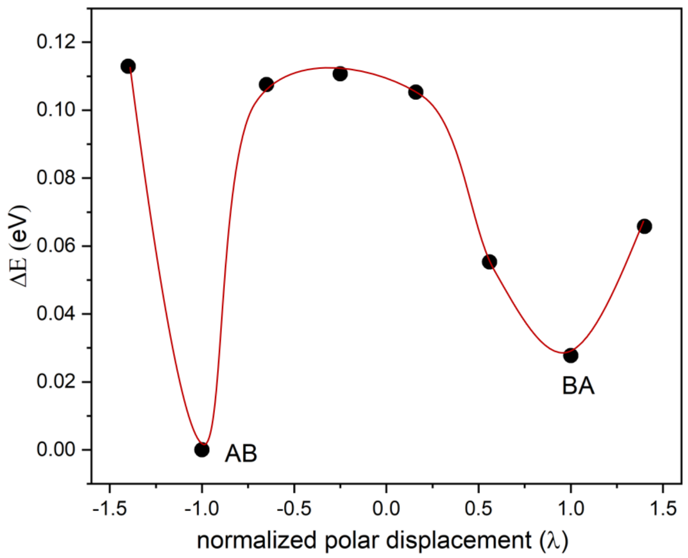


Figure S9. Energy profile as a function of polar displacement in the Au/Gr/BBN/Gr/Au FTJs. The polar displacements λ are normalized and λ=1 and -1 represent the AB and BA stacks, respectively. The energy of the AB-stack FTJ refers to zero.

References:

[1] Bokdam, M., Brocks, G., Katsnelson, M. I. & Kelly, P. J. Schottky barriers at hexagonal boron nitride/metal interfaces: A first-principles study. *Phys. Rev. B* **90**, 085415, doi:10.1103/PhysRevB.90.085415 (2014).

[2] Wang, Y. *et al.* Schottky barrier heights in two-dimensional field-effect transistors: from theory to experiment. *Rep. Prog. Phys.* **84**, 056501, doi:10.1088/1361-6633/abf1d4 (2021).