

Supporting Information

Enlarging the frequency threshold range of Bienenstock-Cooper-Munro rules in WO_x -based memristive synapses by Al doping

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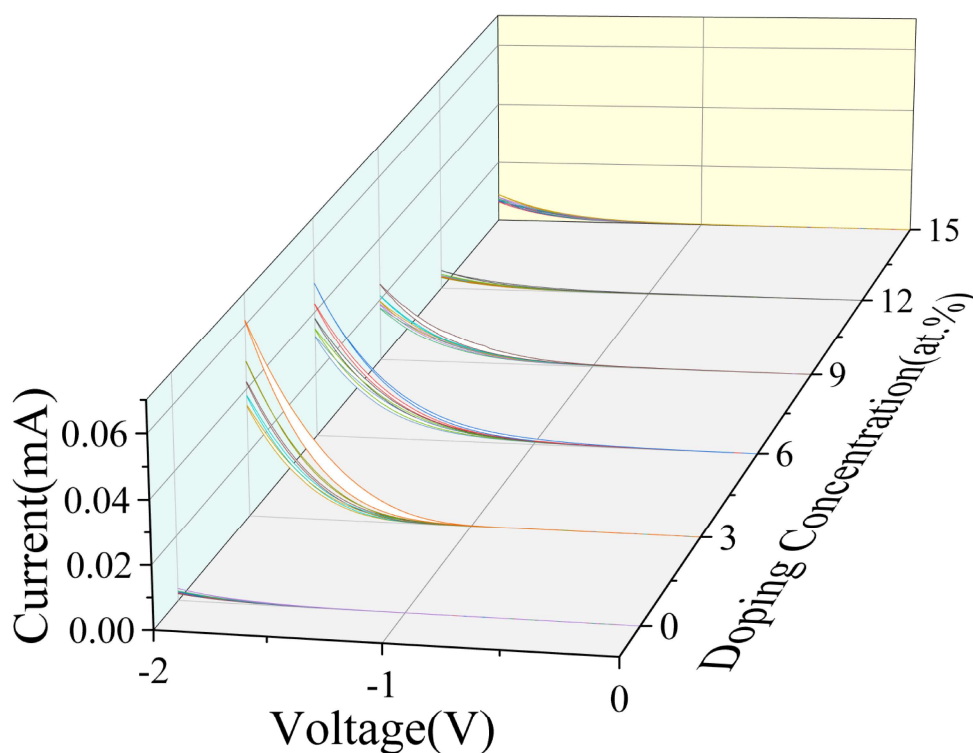


Figure S1. *I-V* characteristic curves of WO_x based devices with different Al doping concentrations in negative voltage direction.

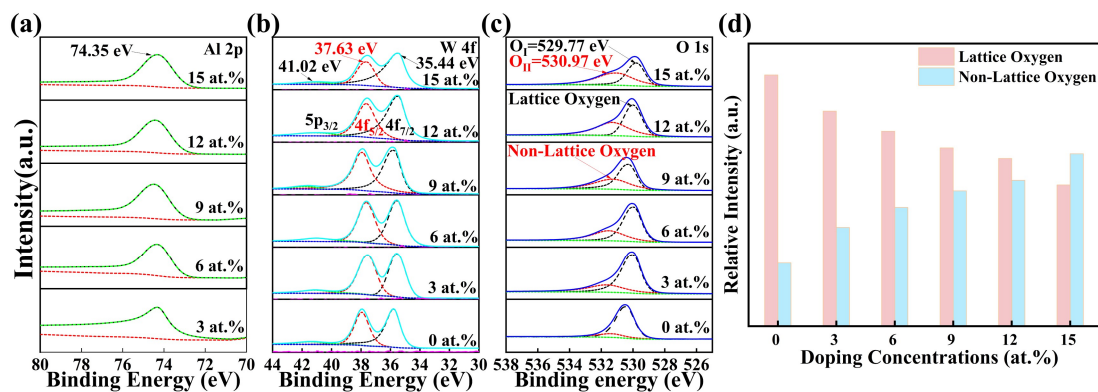


Figure S2. XPS spectra of a) Al 2p and b) W 4f and c) O 1s core levels of Al:WO_x films. d) The relative content statistics of lattice oxygen and non-lattice oxygen of Al:WO_x films.

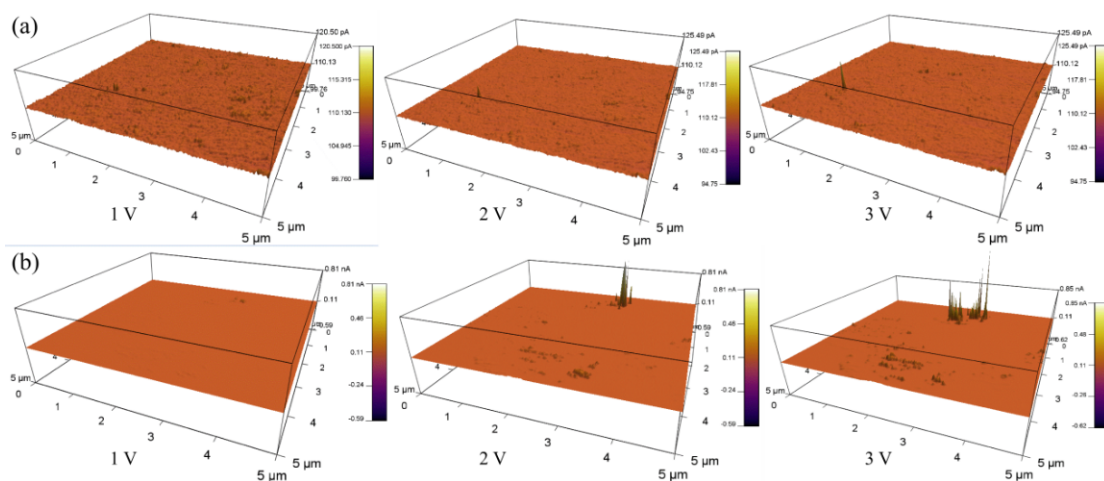


Figure S3. C-AFM test results at 1-3 V of the device a) Au/WO_x/Ti and b) Au/Al:WO_x(9 at.%) /Ti.