

RESEARCH ARTICLE

Carbon dot-stabilized magnesium quantum dots for high-performance memristors and driven pulse diagnosis in traditional Chinese medicine

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Supporting Information

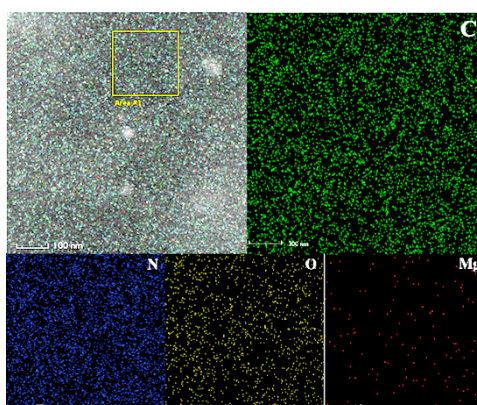


Fig. S1 Elemental (C, N, O, and Mg) mapping analysis for the Mg-CDs.

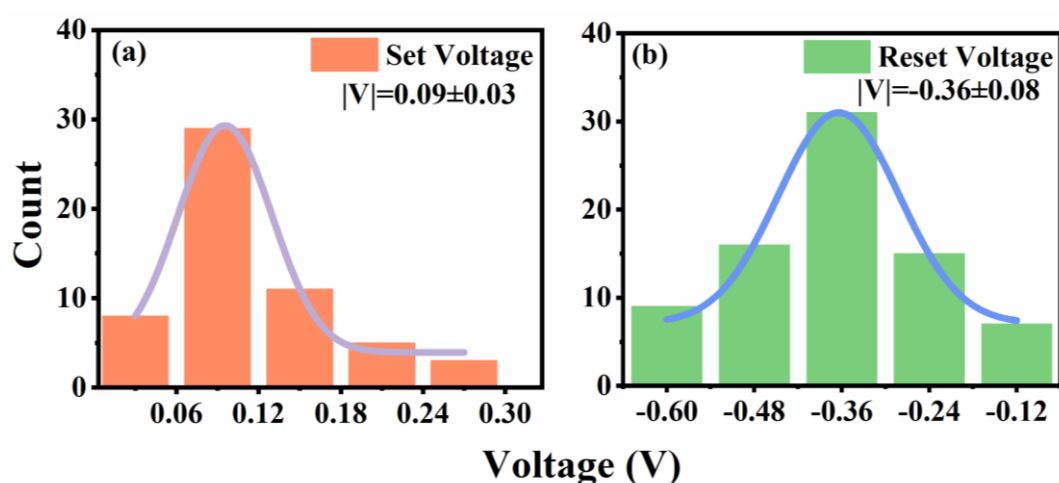


Fig. S2 SET voltages (a) RESET voltages (b) distribution for Mg-CDMD and Gaussian fitted curves.

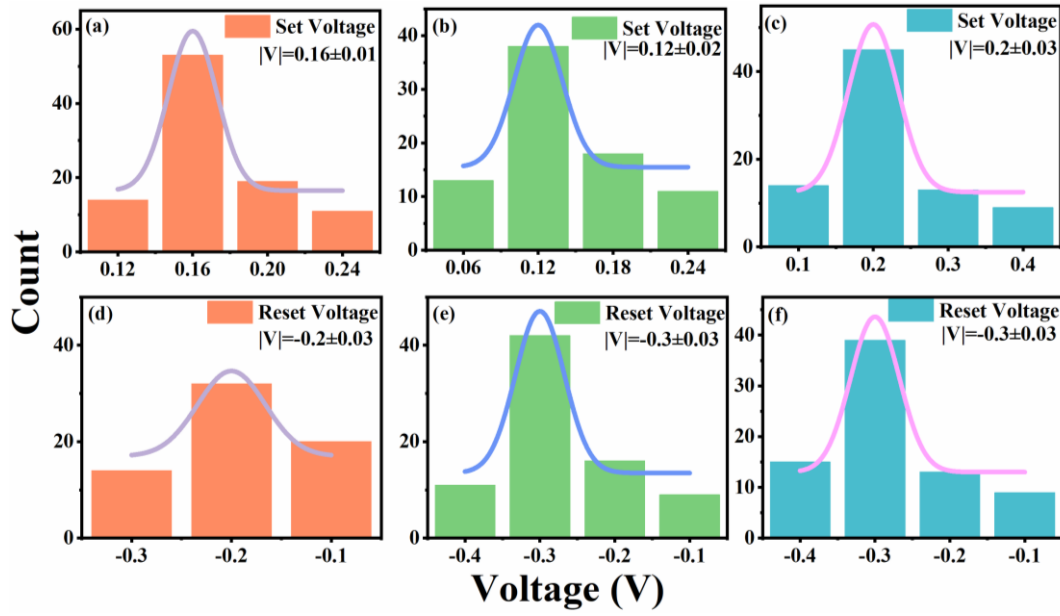


Fig. S3 SET voltages distribution ((a), (b) and (c)) and RESET voltages distribution ((d), (e) and (f)) of the first, second, and third batches of Mg-CDMD. The curves are Gaussian fits to the histograms.

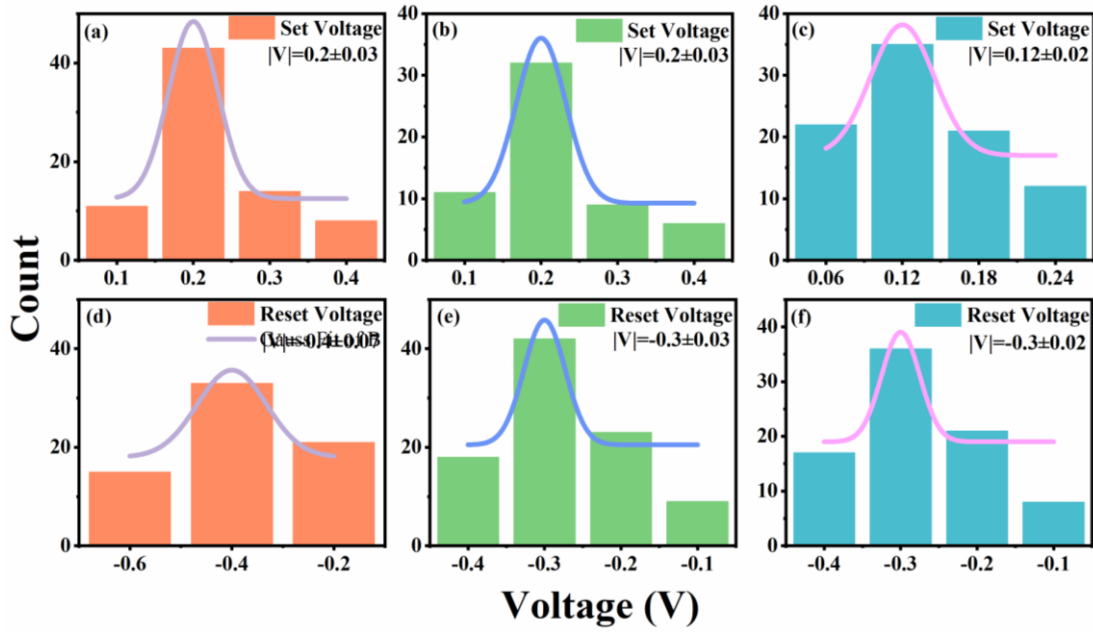


Fig. S4 SET voltages distribution ((a), (b) and (c)) and RESET voltages distribution ((d), (e) and (f)) of the first, second, and third devices of Mg-CDMD. The curves are Gaussian fits to the histograms.

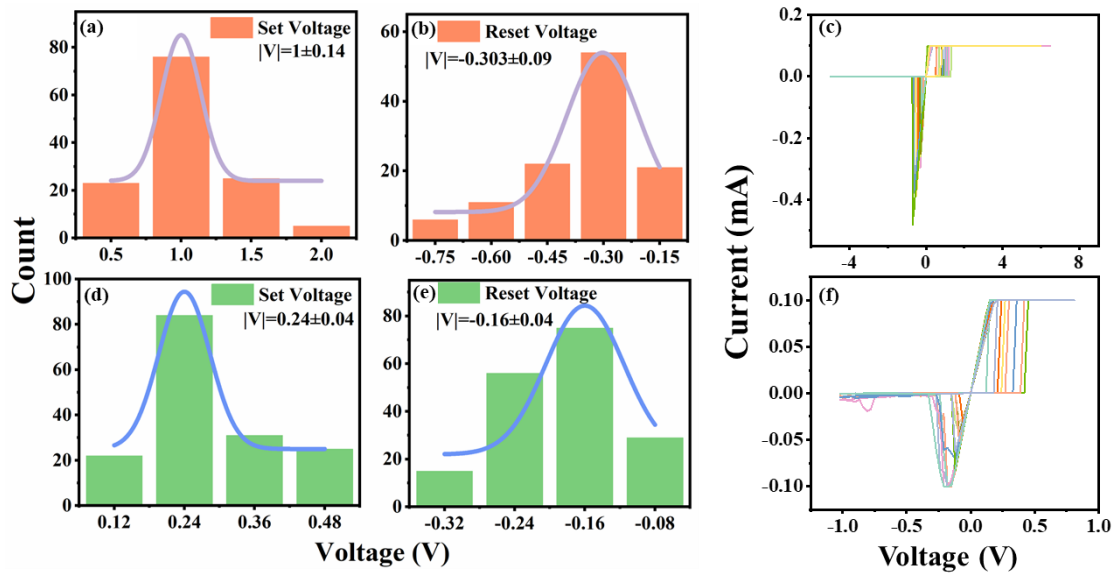


Fig. S5 SET voltages and RESET voltages distribution of Ag/MoO₃/Mg-CDs/Pt (a, b) and Ag/ZrO₂/Mg-CDs/Pt (d, e) memristors, respectively. And the curves are Gaussian fits to the histograms. (c) and (f) show the I-V curves of the Ag/MoO₃/Mg-CDs/Pt and Ag/ZrO₂/Mg-CDs/Pt devices, respectively.

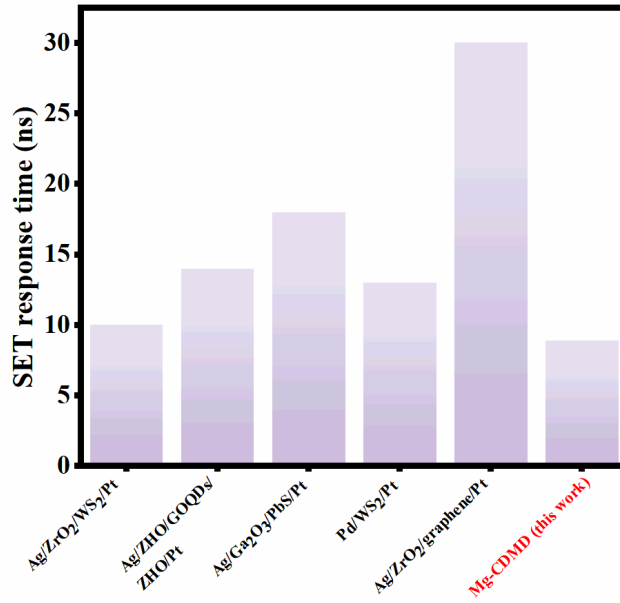


Fig. S6 SET response speed of memristors in the literatures.

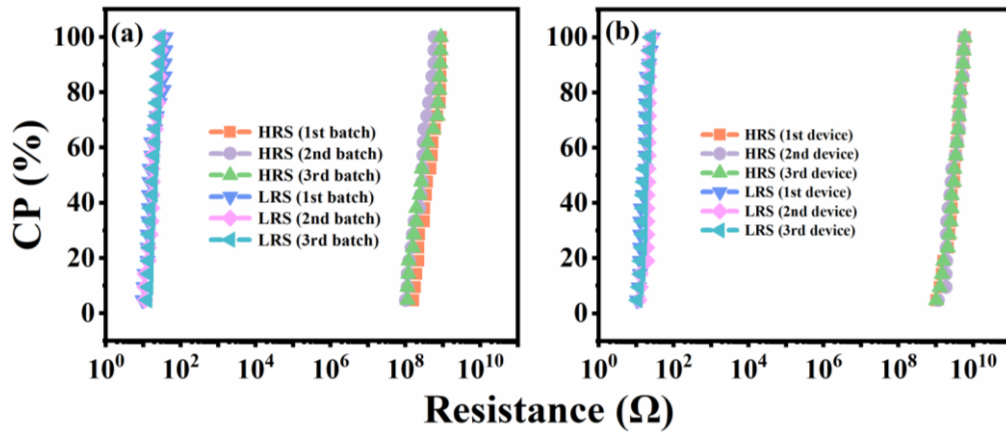


Fig. S7 Resistance distribution statistics of three batches (a) and three devices (b) of Mg-CDMD.

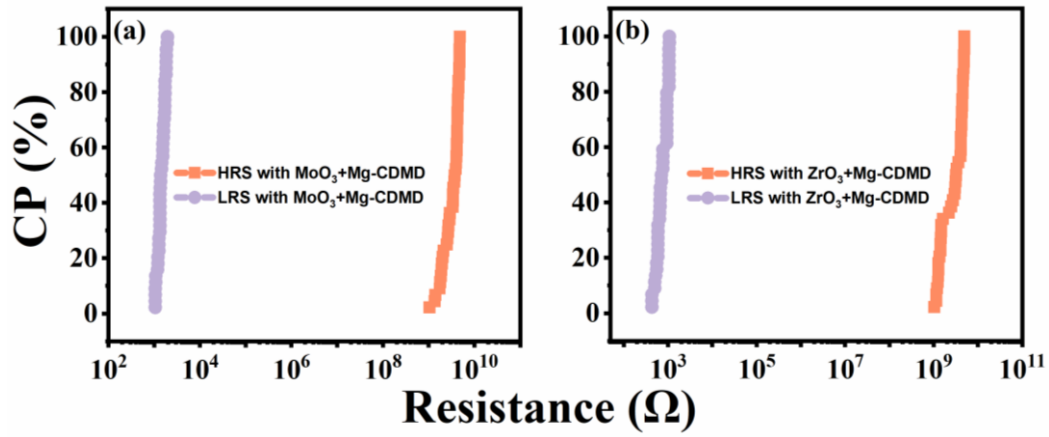


Fig. S8 Resistance distribution statistics of (a) Mg-CDMD (MoO_3), (b) Mg-CDMD (ZrO_2).

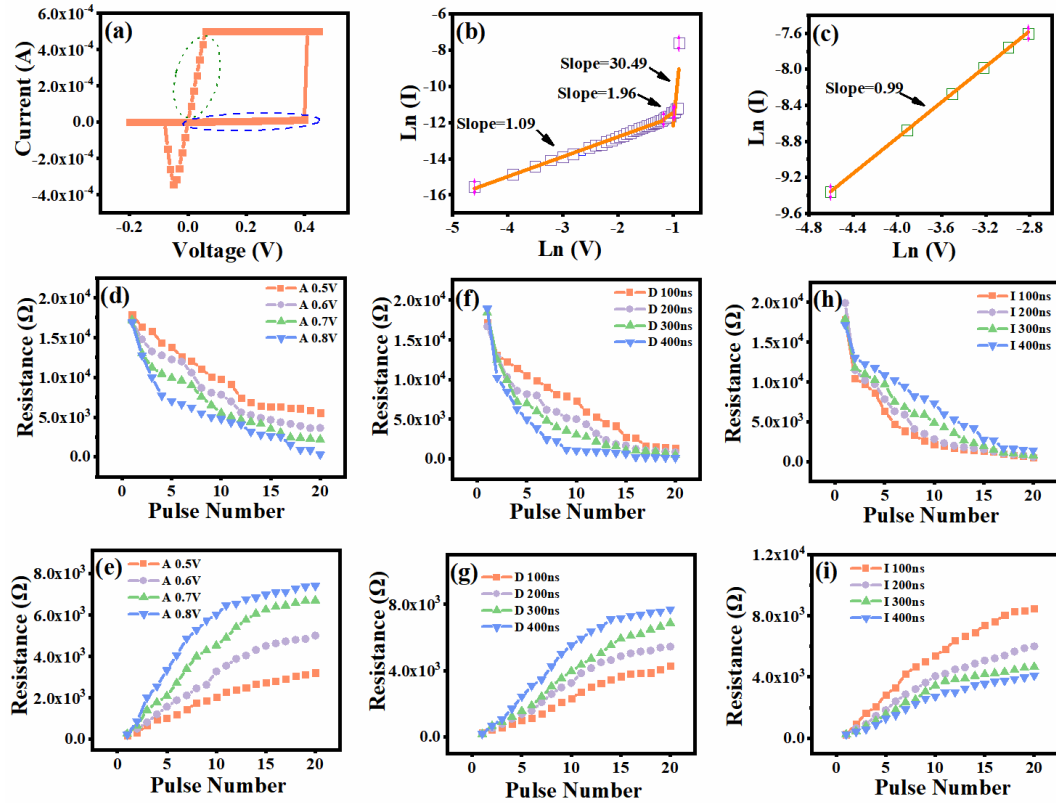


Fig. S9 Conductive mechanism of Mg-CDMD and the influence of different pulse sequences on Mg-CDMD resistance. (a) I-V curve of Mg-CDMDs. (b) The curve inside the blue ellipse is in figure S9(a). (c) The curve inside the green ellipse is in figure S9(a). (d) The effect of positive voltage's amplitude on Ag/HfO₂/Mg-CDs/Pt device's resistance with fixed duration and interval. (e) The effect of negative voltage's amplitude on Ag/HfO₂/Mg-CDs/Pt device's resistance with fixed duration and interval. (f) The effect of duration of positive voltage on Ag/HfO₂/Mg-CDs/Pt device's resistance with fixed amplitude and interval. (g) The effect of duration of negative voltage on Ag/HfO₂/Mg-CDs/Pt device's resistance with fixed amplitude and interval. (h) The effect of the interval of positive voltage on Ag/HfO₂/Mg-CDs/Pt device's resistance with fixed duration and amplitude. (i) The effect of the interval of negative voltage on Ag/HfO₂/Mg-CDs/Pt device's resistance with fixed duration and amplitude.

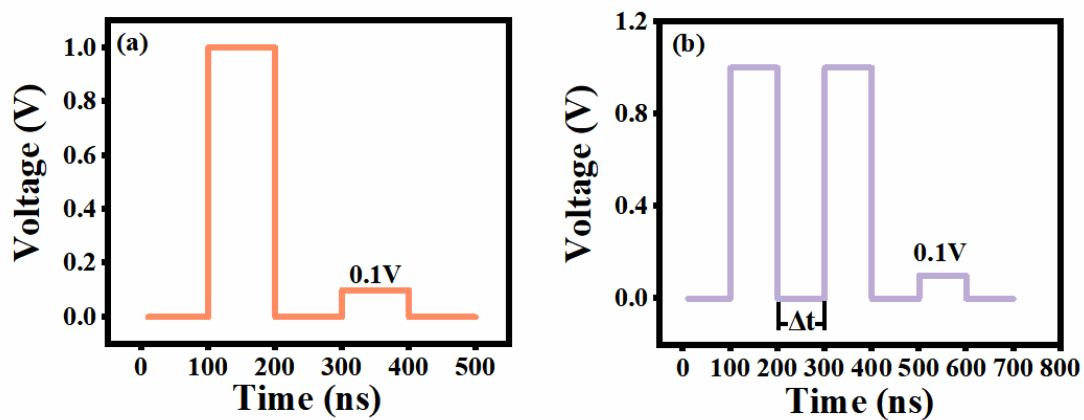


Fig. S10 (a) The pulse signal waveform used to measure the strength of the pulse condition. (b) The pulse signal waveform used to determine the pulse condition interval.

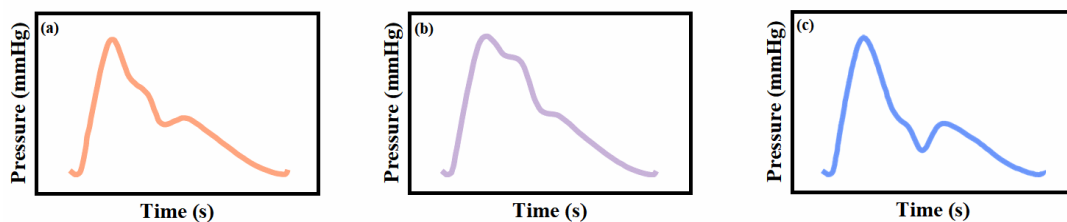


Fig. S11 The typical waveforms of (a) the normal pulse, (b) the string-like pulse (c) the slippery pulse.

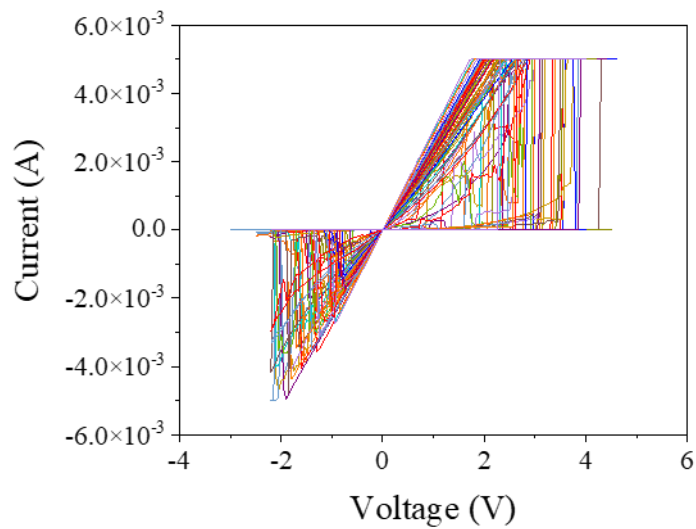


Fig. S12 IV curve without quantum dot devices.

Table 1 S13 Performance comparison between our device and existing state-of-the-art works.¹⁻¹⁴

Device	V _{SET}	V _{RESET}	R _{ON/OFF}	Endurance	Set speed	Reset speed	Set power	Reset power	references
Ag/SZO/Au/Ti/SiO ₂	1V	-0.75V	10 ⁴	100 cycle	-	-			[1]
Ag/Zn _{1-x} Cu _x O/FTO	1.5V	-1.5V	10 ⁵	10 ⁶ cycle	-	-			[2]
Cu/Cu-doped TiO ₂ /Al	1.5V	-0.7V	10	-	-	-	1.5×10 ⁻⁴ W	7×10 ⁻⁵ W	[3]
Pt/Ti/GeSe/TiN	0.75V	-	-	-	-	-			[4]
Fe-doped SnSe	-1.6V	1.6V	-	-	-	-	1.6×10 ⁻² W	1.6×10 ⁻² W	[5]
Ag/Cr-N-doped TiO ₂ /Ag	0.9V	-0.9V	2.5×10 ³	-	-	-	9×10 ⁻⁵ W	9×10 ⁻⁵ W	[6]
Ag/WS ₂ QDs/LSMO/STO	0.52V	-0.19V	5×10 ³	100 cycle	-	-	0.16nW	6nW	[7]
Al/MWCNT:GQD/ITO	2.5V	-1V	4.58×10 ³	10 ⁵ cycle	-	-	2×10 ⁻¹ W	3×10 ⁻¹ W	[8]
Au/ α -CsPbI ₃ QDs/PEDOT: PSS/ITO	1V	-1.3V	8×10 ⁴	800cycle	-	-	1×10 ⁻³ W	1.3×10 ⁻² W	[9]
TiN/WO ₃ /FTO	1.75V	-4V	-	-	700ps	2.7ns	1.75×10 ⁻⁵ W	4×10 ⁻⁶ W	[10]
Al/InGaP QDs/HfO ₂ /ITO	-0.95V	0.9V	-	-	300ns	400ns	9.5×10 ⁻⁶ W	3×10 ⁻⁷ W	[11]
N-doped carbon dots	2V	-	-	-	28ns	28ns	-	-	[12]
Al/PMMA/NCDs/PMMA/NCDs/PS/ITO	1V	-2V	-	-	70ns	45ns	10 ⁻³ W	2×10 ⁻² W	[13]
Al/Bi ₂ S ₃ /ITO	0.6V	-0.7V	50	-	-	-	6×10 ⁻⁴ W	7×10 ⁻⁴ W	[14]
Ag/HfO ₂ /Mg-CDs/Pt	0.09V	-0.3V	10 ⁶	10 ¹⁰ cycle	8.9ns	17ns	1.51×10 ⁻⁸ W	1.06×10 ⁻⁷ W	This work

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