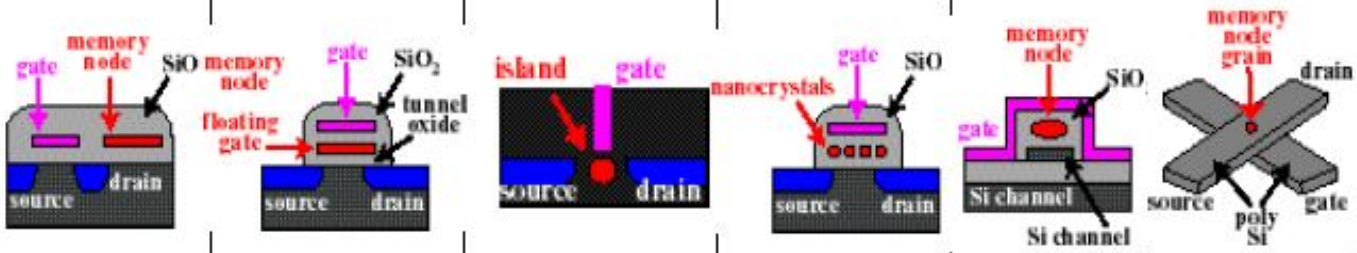
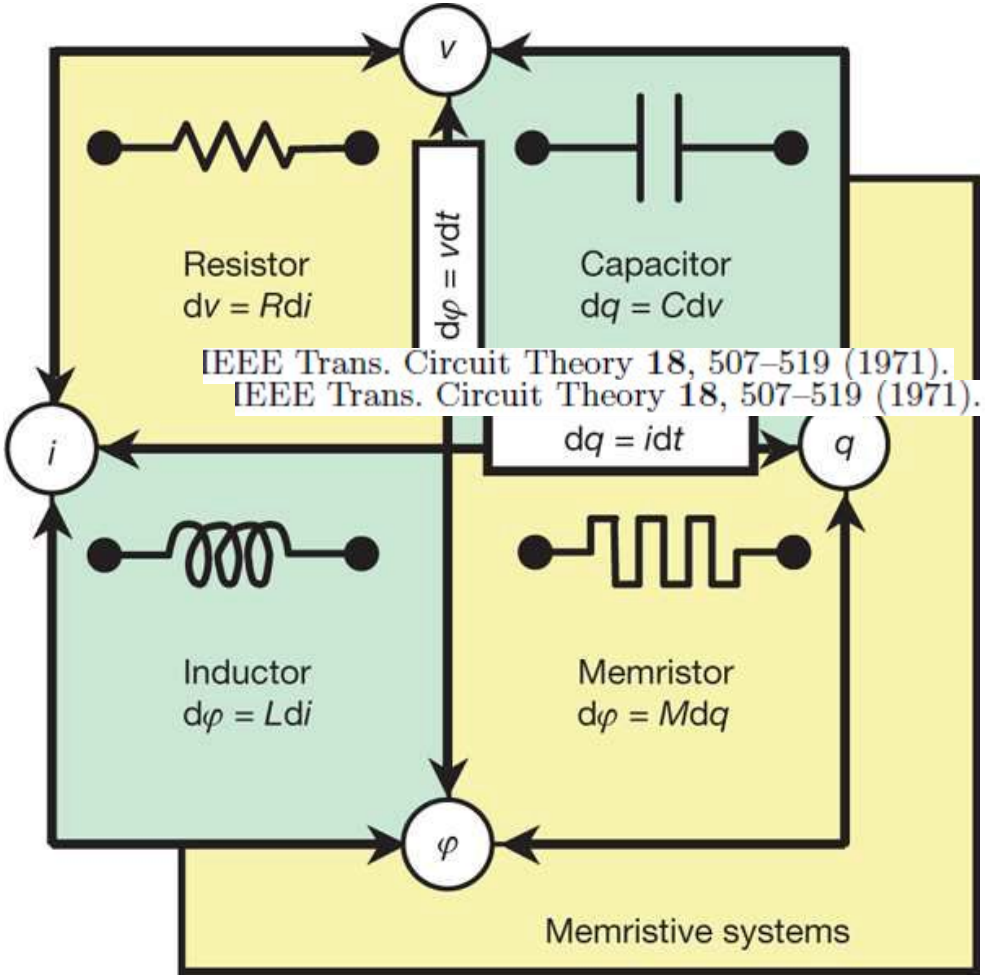
МЕМРИСТОР.

Память о прошлом
или память будущего.

ПАМЯТЬ

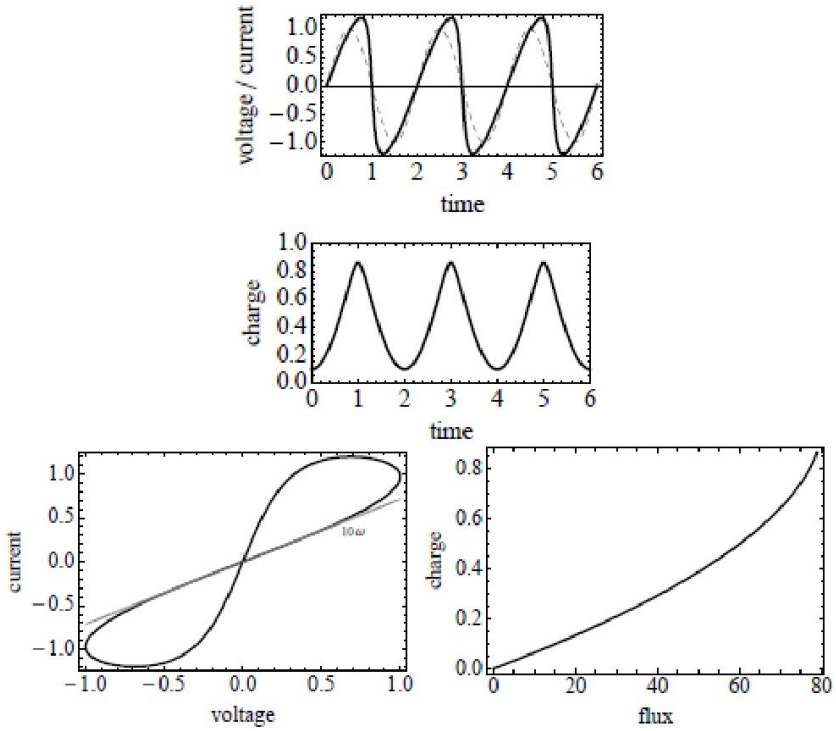
	DRAM	Flash	SET	Nano-flash		Yano-type
				Multidot	Single dot	
device structure						
read time	~10 ns	~10 ns	1 ns	~10 ns	~10ns	~20 μs
write time	~10 ns	~1 ms	1 ns	~100 ns	<1 μs	~10 μs
erase time	< 1nm	~1ms	< 1nm	~1 ms	<1 ms	~10 μs
retention time	~1 s	~10 years	~ 1s	~1 week	~5 s	~1 day
endurance cycles	infinite	10^6	infinite	10^9	10^9	10^7
operating voltage	3 V	15 V	1 V	5 V	10 V	15 V
voltage for state inversion	0.2 V	~5 V	< 0.1 V	0.65 V	0.1 V	0.5 V
electron number to write bit	10^5	10^3	1 (excluding no to change gate potential)	10^3	1 (excluding no to change gate potential)	2 (excluding no to change gate potential)
cell size	~12 F^2/bit	~9F^2/bit	9-12 F^2/bit	9F^2/bit	9F^2/bit	2F^2/bit

L. O. Chua, “Memristor—the missing circuit element,” (1971).



IEEE Trans. Circuit Theory 18, 507–519 (1971).
IEEE Trans. Circuit Theory 18, 507–519 (1971).

D. B. Strukov, G. S. Snider, D. R. Stewart, and R. S.Williams, “The missing memristor found,” Nature 453, 80–83 (2008).



- $v = R(x)i$ $\qquad \frac{dx}{dt} = F(x,i)$

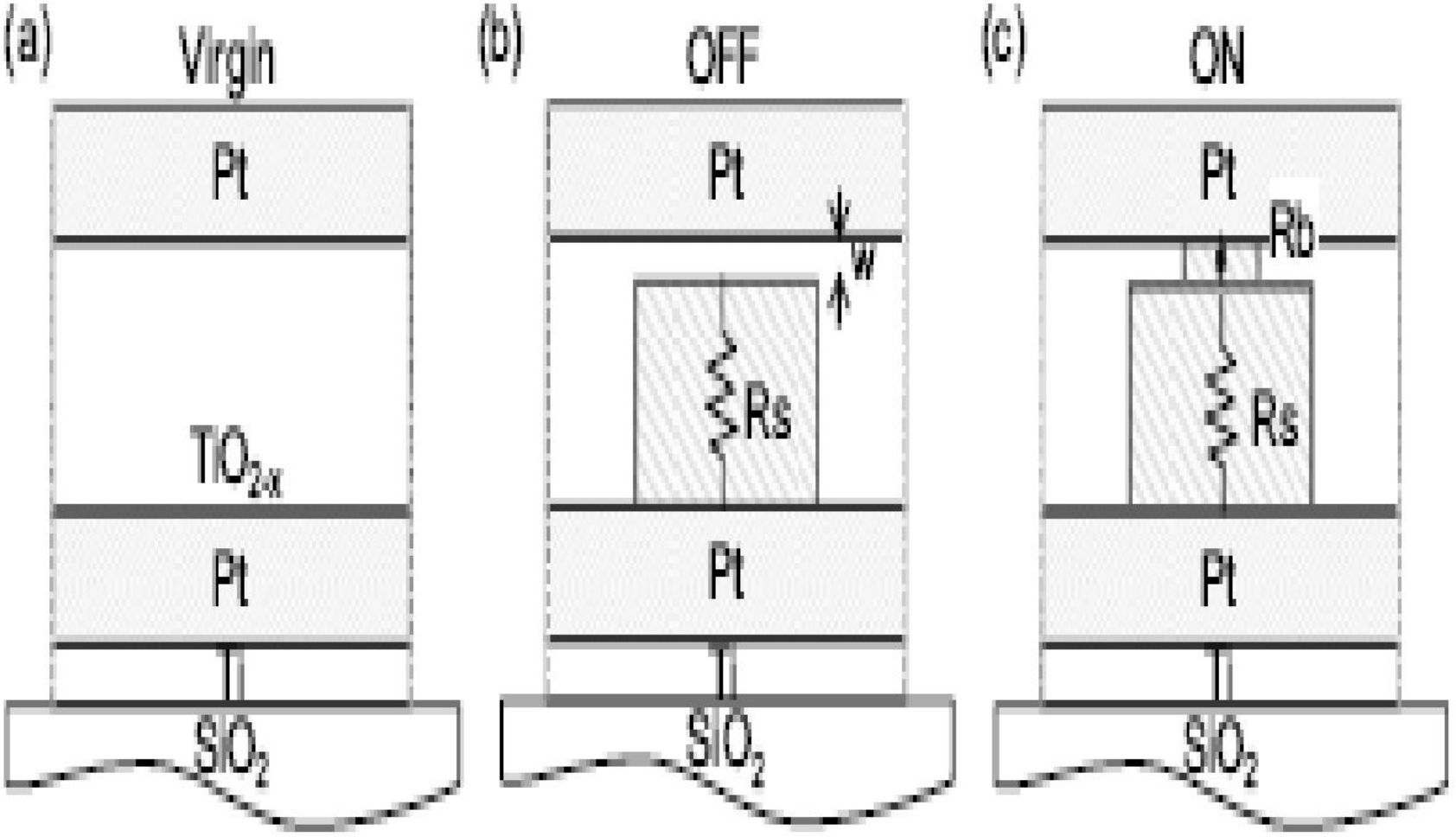
$$v(t) = \{x(t)R_{ON} + [1 - x(t)R_{OFF}\}i(t)$$

$$\varphi = -\frac{R_{ON}\mu}{2D^2}\left(\frac{R_{OFF}}{R_{ON}} - 1\right)q^2 + R_{OFF}q$$

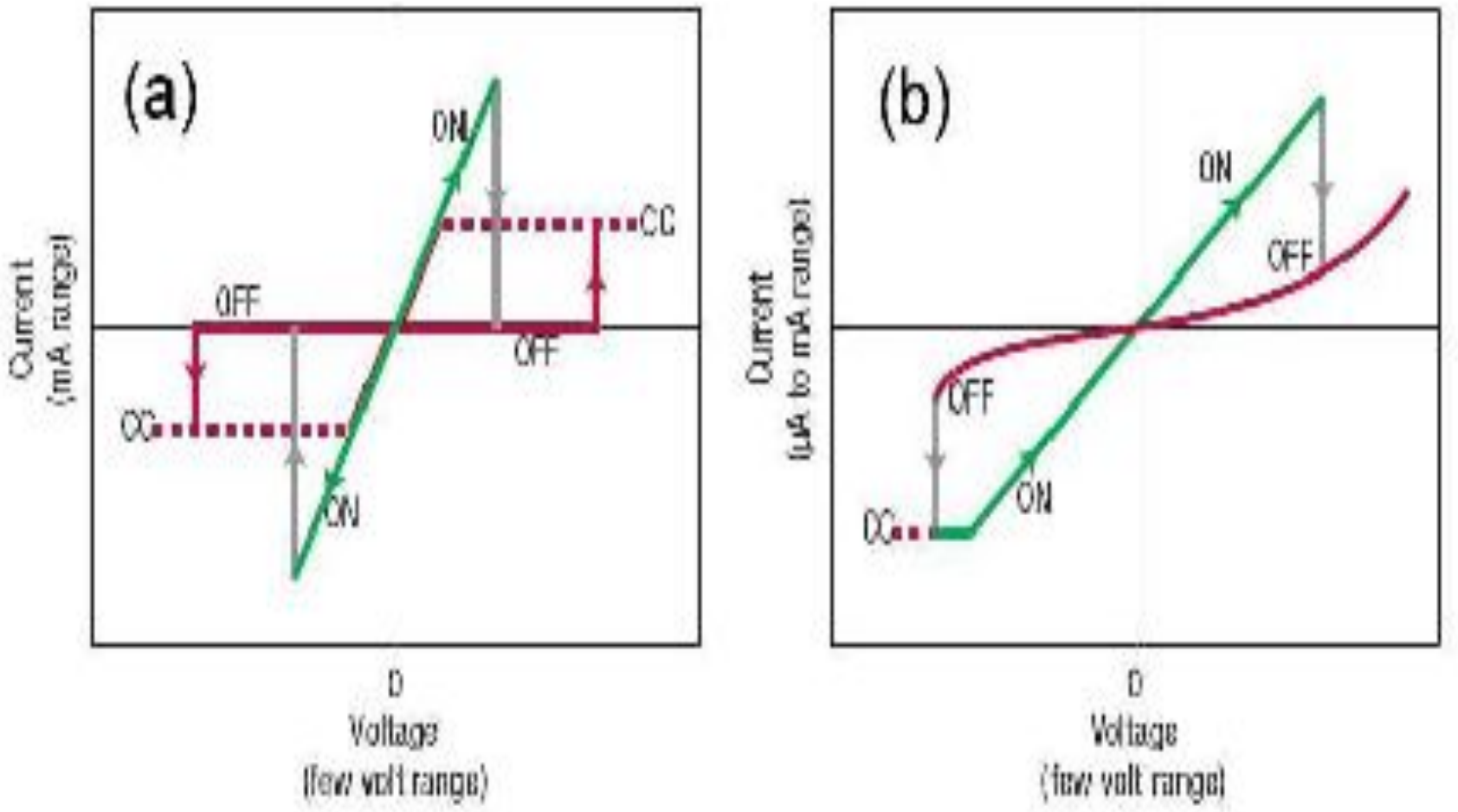
$$M(q) = d\varphi / dq = R_{off}(1 - \mu V R_{on} q / D^2)$$

$$\frac{d}{dt}\varphi = v = \frac{d\varphi}{dq}\frac{dq}{dt} = M(q)i$$

Модель


(a)
Virgin
Pt
TiO_{2-x}
Pt
SiO_2
(b)
OFF
Pt
w
Rs
Pt
SiO_2
(c)
ON
Pt
Rb
Rs
Pt
SiO_2

Униполярное переключение (a)
Биполярное переключение (b)



Изменение концентрации вакансий возле катода и анода в октаэдрическом окружении атомов Cr в Cr:SrTiO3

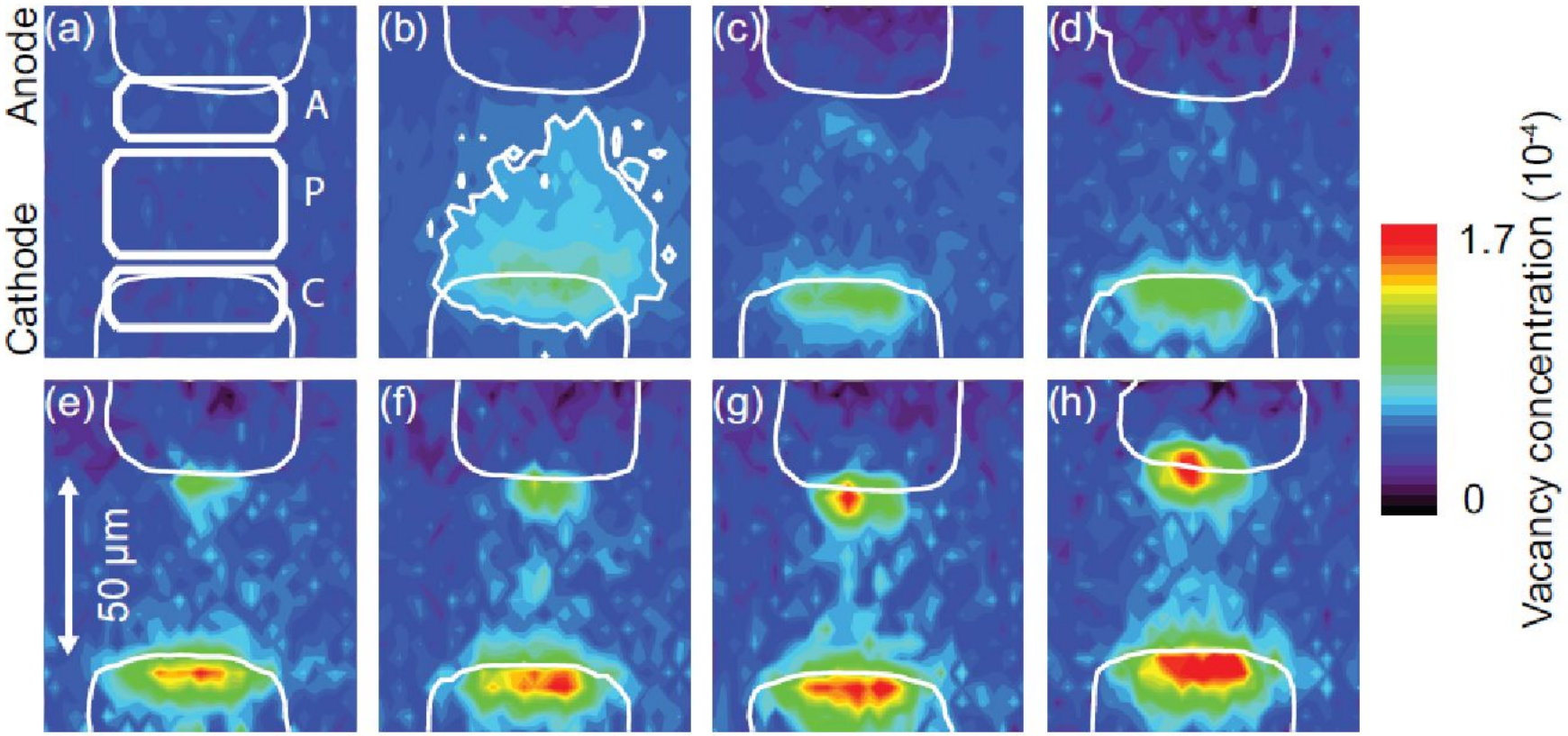
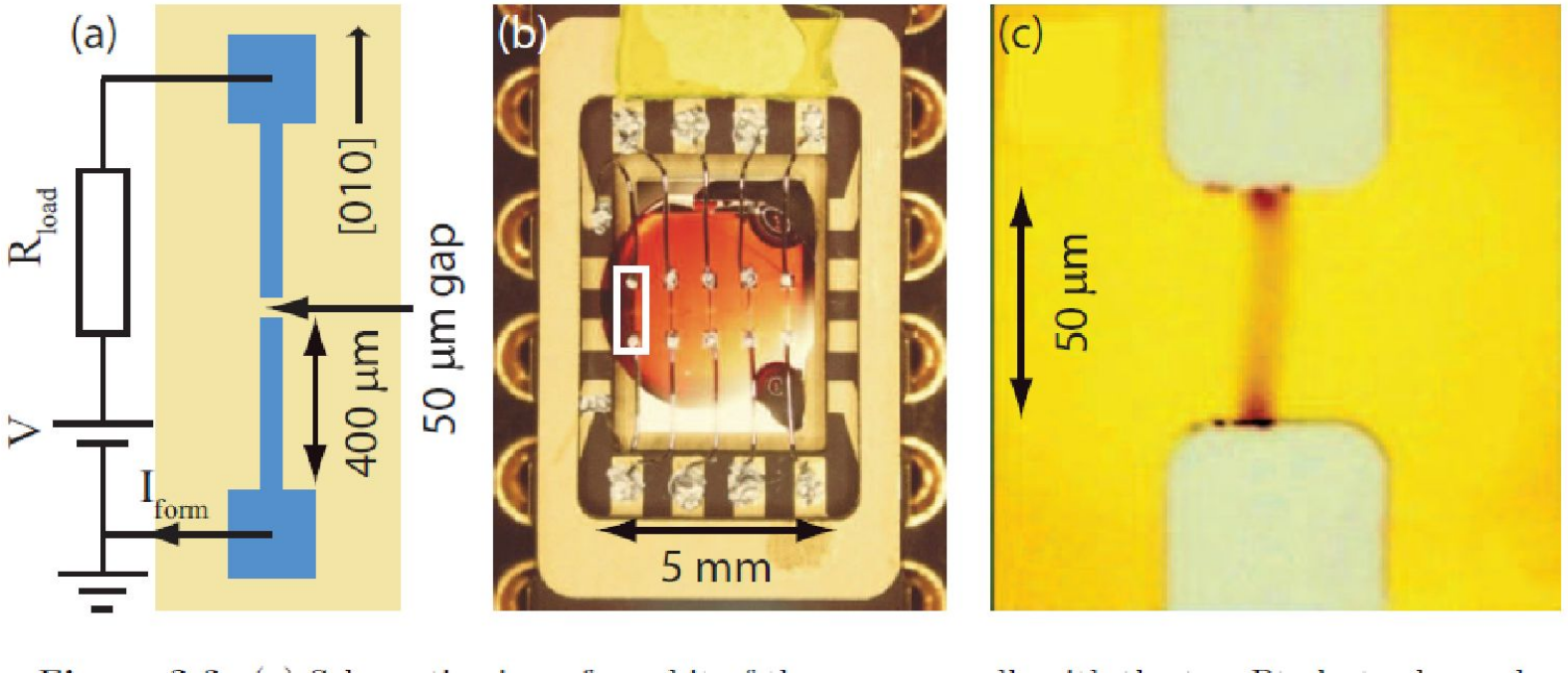
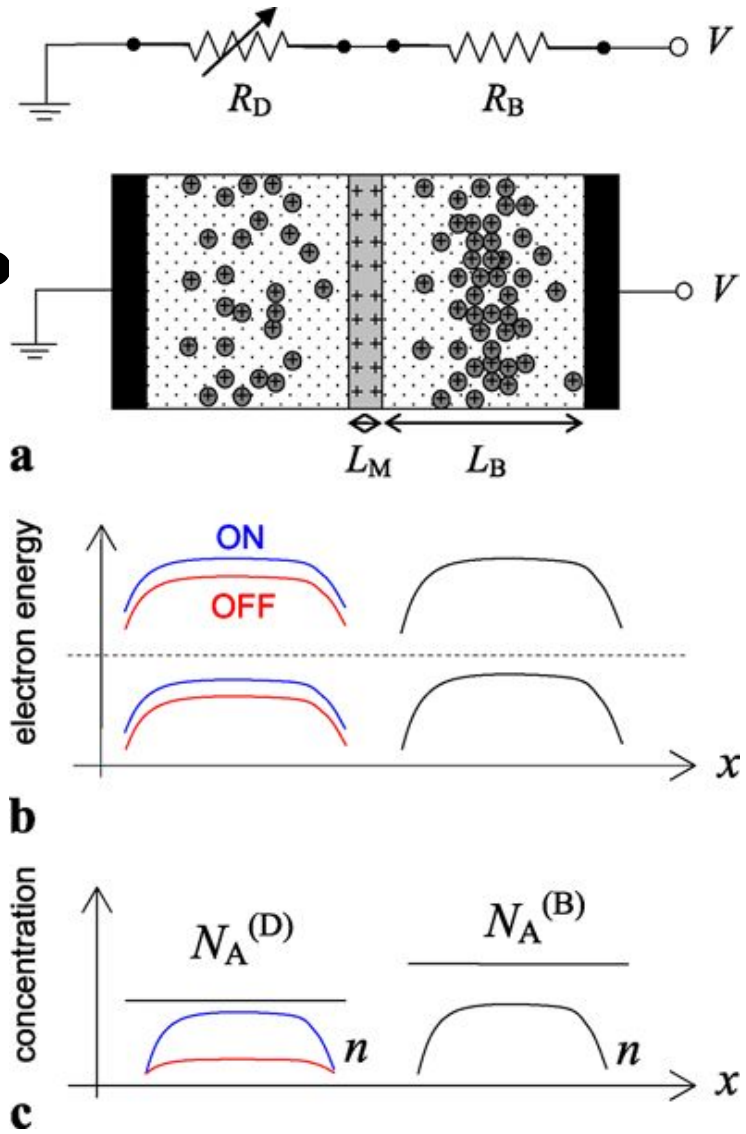


Figure 4.4: μ-XRF maps at an X-ray energy of 6004.3 eV showing the distribution of the

Пример исследуемых структур мемристора



ГОРЛЫШКО


V
R_D
R_B
V
a
L_M
L_B
ON
OFF
electron energy
x
b
concentration
$N_A^{(D)}$
$N_A^{(B)}$
n
n
x
c