Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

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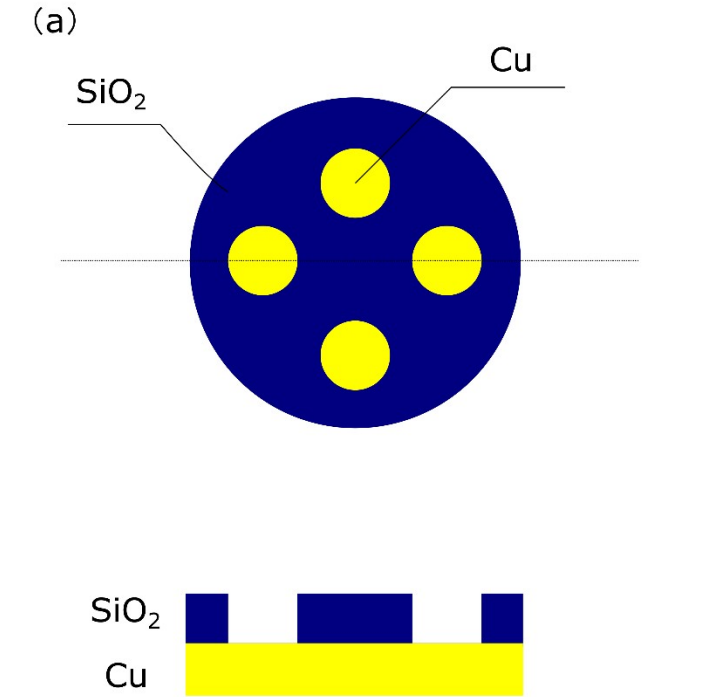

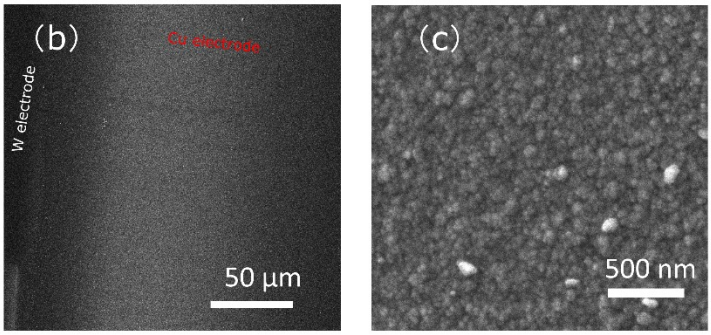

Figure S1 (a) the configraion of composite target; (b)-(c) the SEM image of f Cu/Cu-doped SiO_2/W device before DC sweep.

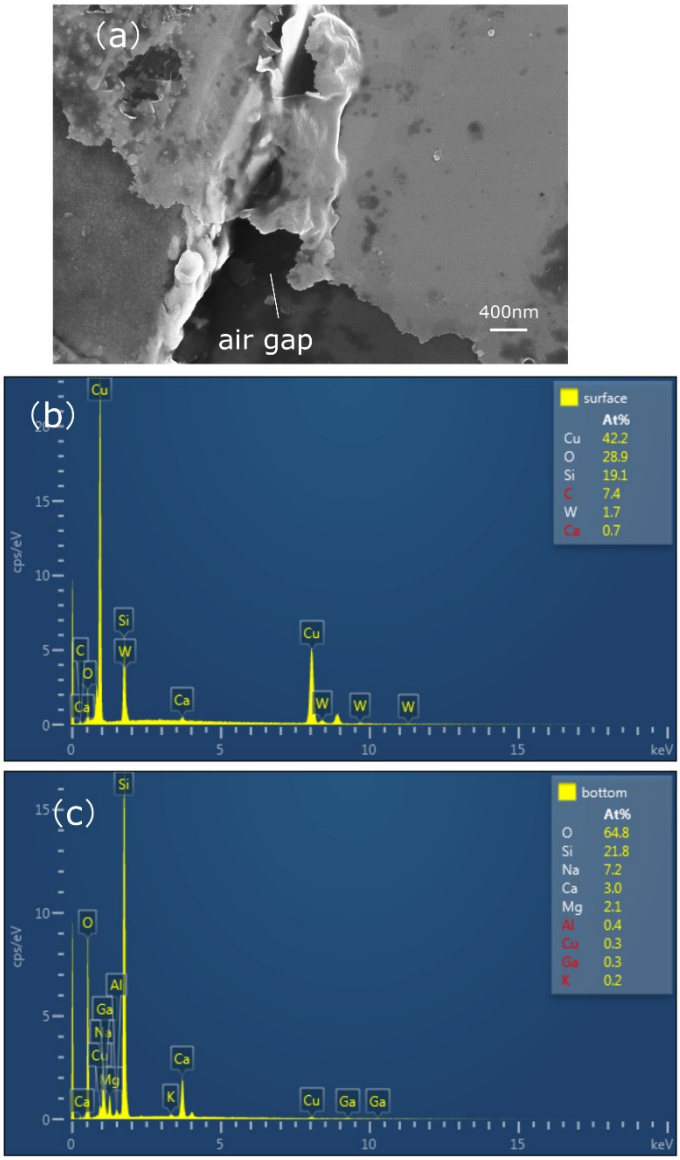

Figure 2 SEM image of Cu-doped SiO_2 after $FeCl_3$ exfoliation; (b) the EDX spectrum in the beginning of sputtering; (c) EDX spectrum after 100s.

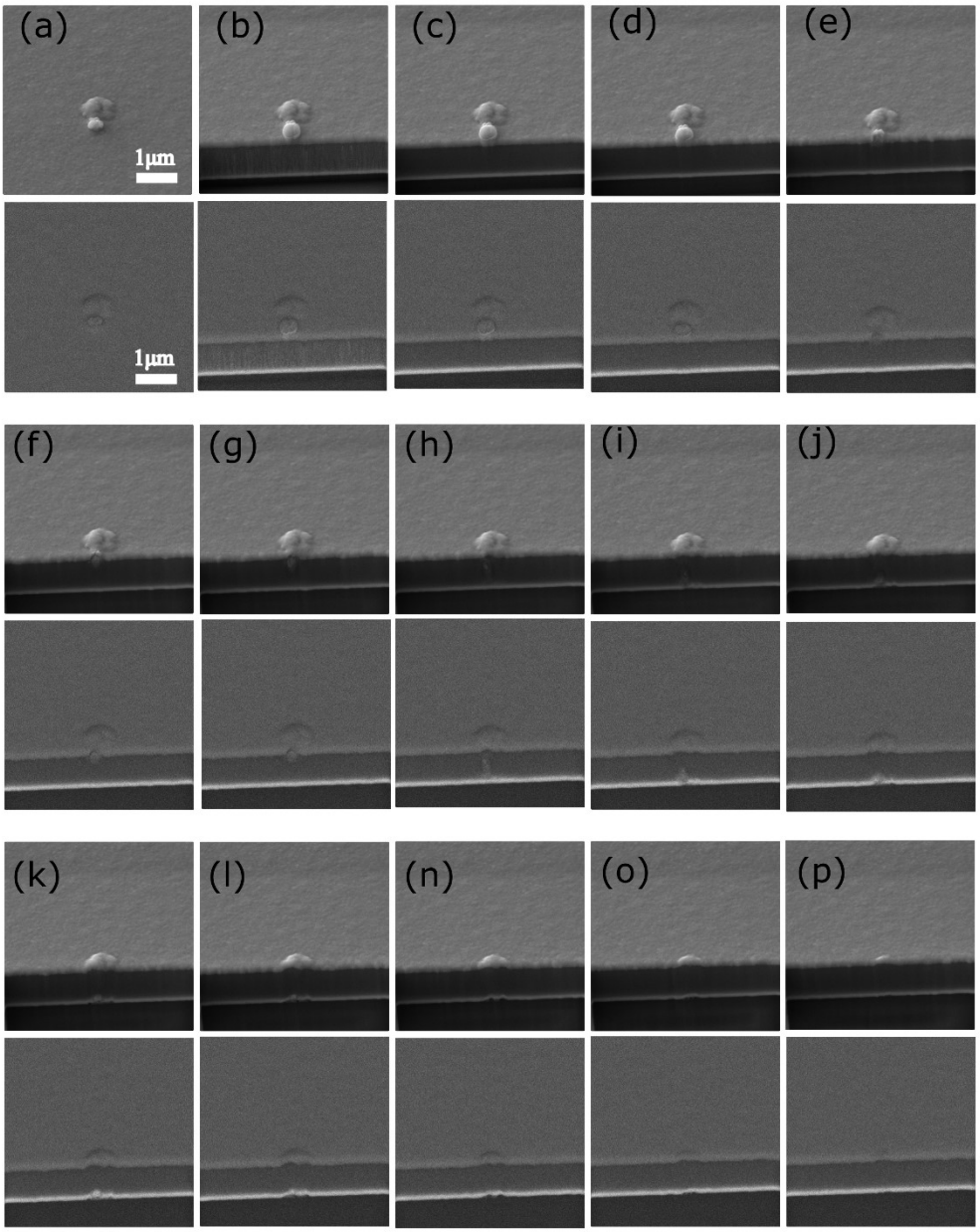

Figure S3 SEM images of Cu/Cu-doped SiO_2/W device milled by FIB method (top SE, bottom BSE).

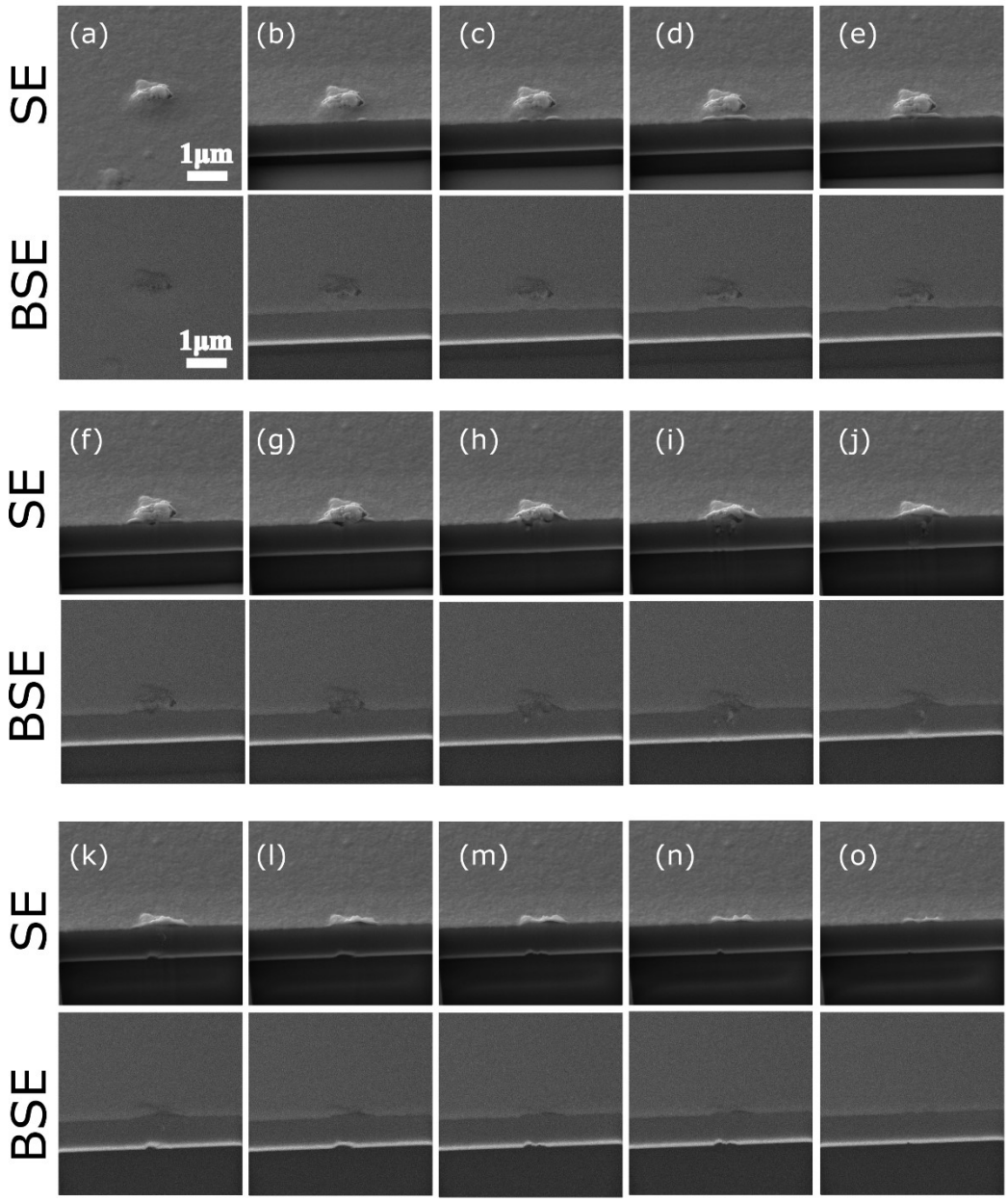

Figure S4 SEM images of Cu/Cu-doped SiO_2/W device milled by FIB method (top SE, bottom BSE).

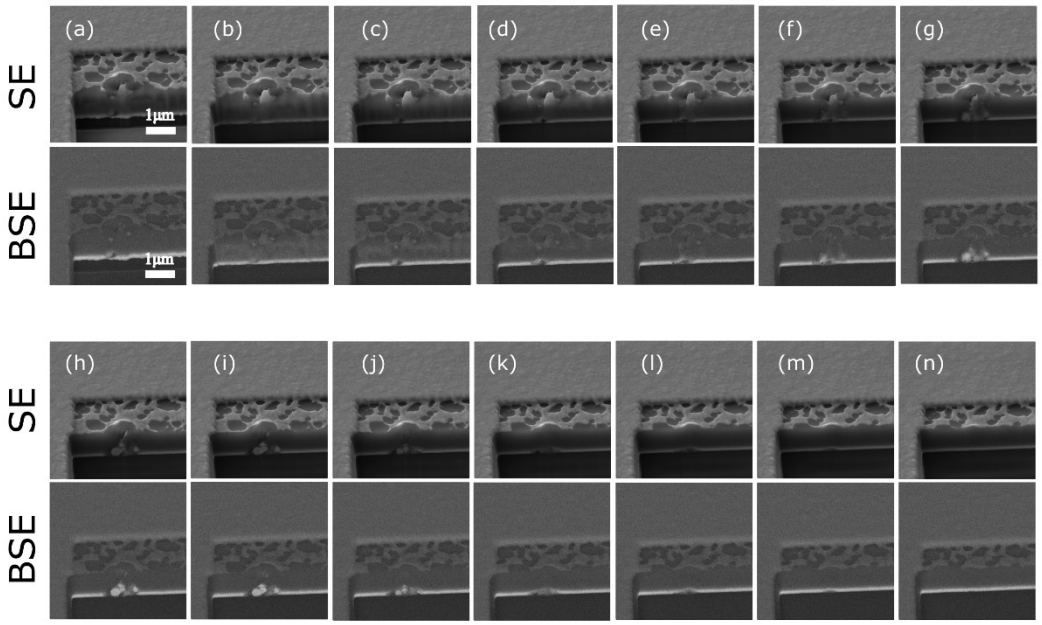

Figure S5 SEM images of Cu/Cu-doped SiO_2/W device milled by FIB method (top SE, bottom BSE).

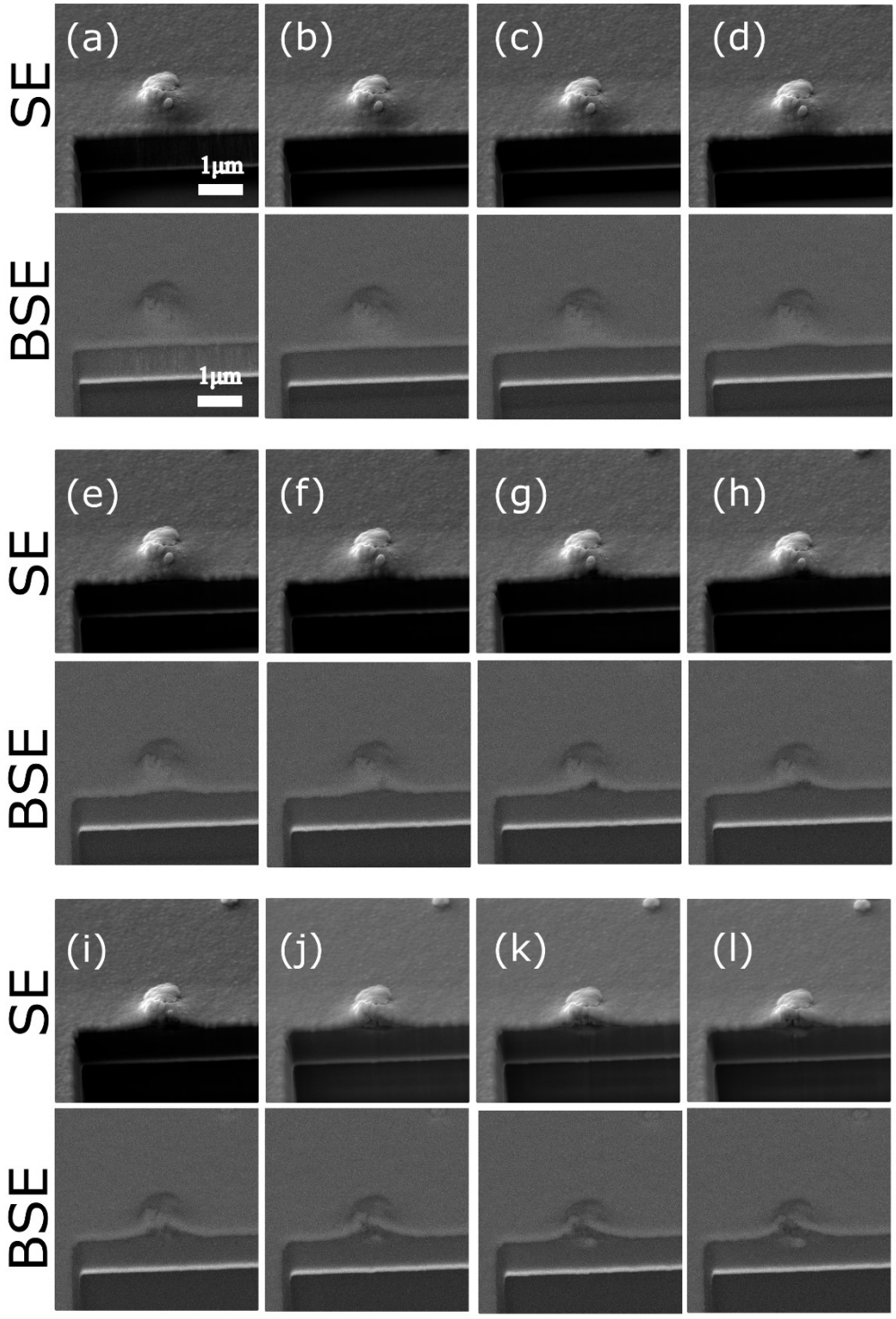

Figure S6 SEM images of Cu/Cu-doped SiO_2/W device milled by FIB method (top SE, bottom BSE).

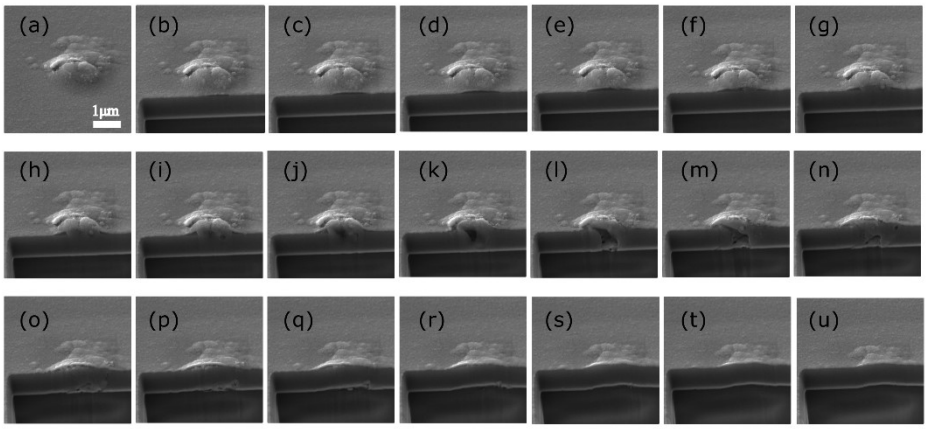

Figure S7 SEM images of Cu/Cu-doped SiO_2/W device milled by FIB method in SE mode

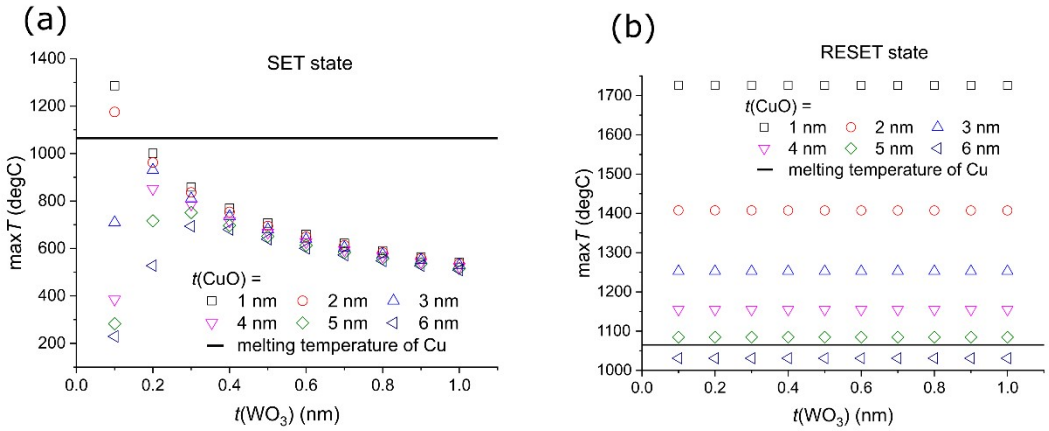

Figure S8 Maximal temperature within the device caused by Jaule Heat calculated via COMSOL as a function of the thickness of WO_3 layer for different CuO thicknesses for (a) SET state, (b) RESET state.

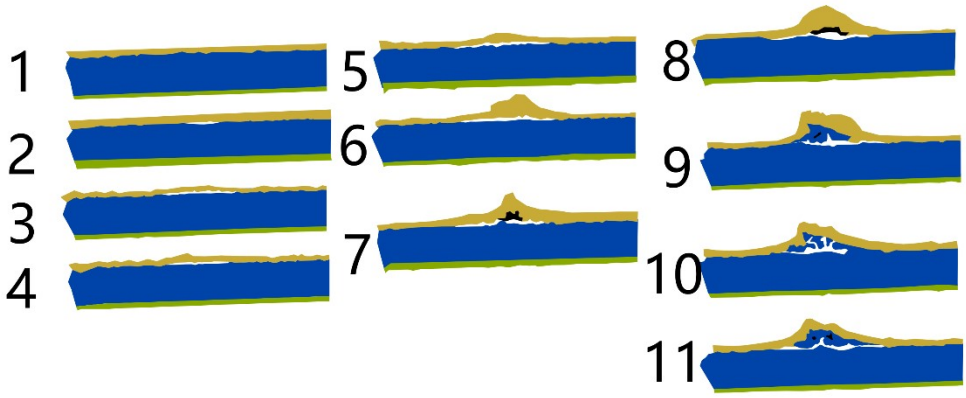

Figure S9 3D reconstruction of defects.

Table S1: The properties of materials used for COMSOL simulation.

	Copper	SiO_2	Tungsten	WO_3	CuO
Density (kg/m^3)	8940	2203	17800	7160	6310
Heat capacity (J/(kgK))	385	703	132	315	532
Relative permittivity	-1e6	3.75	-1e6	10.5	18.1
Electrical conductivity σ (S/m)	1.68e-8 *(1+0.00386*(T-T0))	1e-14	5.6e-8 *(1+0.0045*(T-T0))	$2 \cdot exp\left(\sqrt{\frac{eV}{kT}}\right)$	$1 \cdot exp\left(\sqrt{\frac{eV}{kT}}\right)$
Thermal conductivity κ (W/(m·K))	$\kappa = \sigma \cdot L \cdot T$	1.38	$\kappa = \sigma \cdot L \cdot T$	1.28	18