

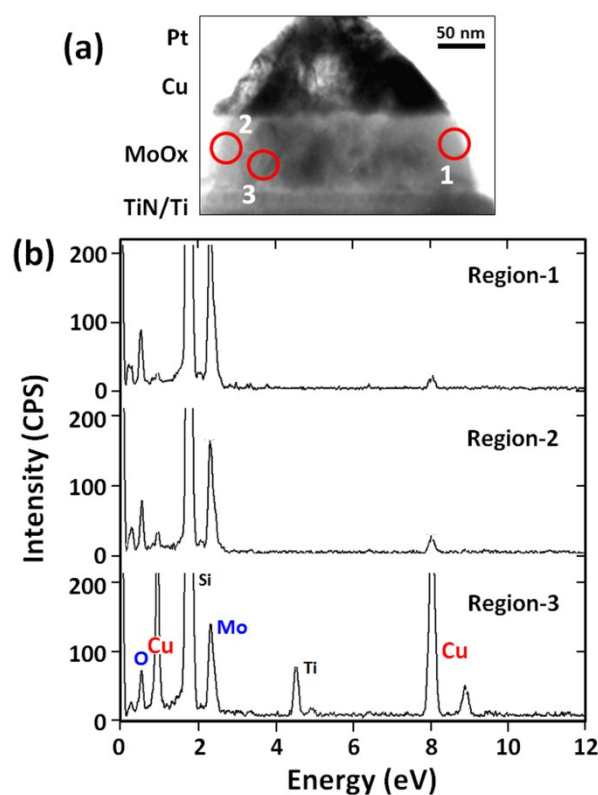
## Supplementary Information (ESI\_3)

Microstructural transitions in resistive random access memory composed of molybdenum oxide with copper during switching cycles

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### EDX analysis of the conductive filament

For characterization of the conductive filament (CF), we measured energy dispersive X-ray spectra (EDX) using a Jeol JEM 2010F microscope with an EDX detector. To maintain the CF during sample transfer from a microscope used for in-situ TEM (Jeol JEM 2010) to this microscope, high power was injected in the set process, and a thick CF was formed. The result is shown in Fig. S1. The investigated regions are marked with circles in Fig. S1(a). The regions 1 and 2 are in MoO<sub>x</sub> without the CF, while the region 3 is at the CF. To prevent signals from the Cu top electrode (TE), the region 3 was established to be apart from the Cu TE as far as possible. As identified in Fig. S1(b), the spectrum from the region 3 contains much stronger Cu peaks than the other regions. Therefore, it was concluded that the CF in this work contained much Cu (probably metallic Cu).



**Fig. S1** (a) TEM photograph of the sample for EDX measurements. Only the region 3 contained the CF. (b) EDX spectra from three regions. The Si peak was from the massive Si substrate, while the Ti peak was from the neighbouring bottom electrode. The region 3 contained much more Cu than regions 1 and 2.