Supplementary Information for

**Real-space observations of 60-nm skyrmion dynamics in an insulating magnet under low heat flow**

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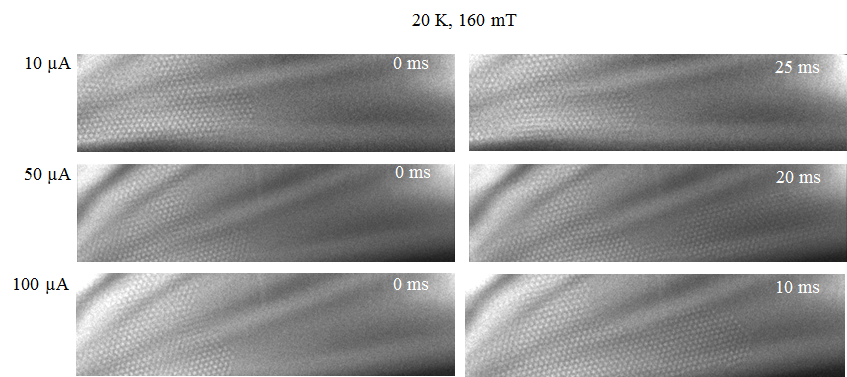
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**Skyrmion motions under various heater currents in the thin Cu2OSeO3**

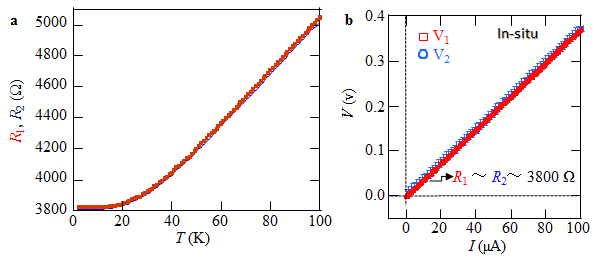
Supplementary Figure 1 shows skyrmion motions under various heater currents in the Cu2OSeO3. When the heater current *I*H is 10 µA, i.e. ~ 0.4 mK/mm, the drift motions of skyrmions do not occur. When *I*H is increased up to 50 µA, i.e. ~ 13 mK/mm, skyrmions move against the heat flow, and simultaneously a skyrmion Hall motion shows up. The *in*-*situ* Lorentz TEM images obtained by systematic observations with increasing *I*H have clearly demonstrated that the velocity and Hall angle of skyrmions increase with increasing , as shown in Fig. 3**k**.



**Supplementary Figure 1**: **Skyrmion motions with heat flows from the right to left sides of the plate**. Left panels show initial magnetic configurations observed at 160-mT-normal field and 20 K. Right panels demonstrate magnetic structures during heat flows.

**Characterization of thermometers on the thin Cu2OSeO3**

We measured temperature dependences of thermometer resistances, as shown in supplementary Figure 2**a**, by using Physical Property Measurements System (PPMS, Quantum Design). Both resistances of R1 and R2 are the same value of ~ 3800 Ω at 20 K. Supplementary Figure 2**b** represent I-V curves measured in TEM chamber, indicating the same resistance for both R1 and R2. Thus, the temperature gradients caused by such weak heater currents are hardly to be evaluated in the present device, at least corroborating such a small heat generation or a low heat flow as estimated by the above simulation.



**Supplementary Figure 2: Resistance curves (a) and *I*-*V* curves (b) of thermometers R1 and R2 in the thin Cu2OSeO3 plate. a.** Resistance profiles of R1 and R2 with decreasing temperature obtained by Physical Properties Measurement System (PPMS) measurements with 1-µA current through the heater and thermometers. **b.** *I*-*V* curves of thermometers R1 and R2 under the same current flow through the heater measured *in*-*situ* in the TEM chamber.