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Supplementary Materials



Fig. S1. Development of wetting ridges in sticking. The height of wetting ridges $\bar{u}_{z_{5}CL}$ with respect to a lapsed time Δt is measured for nine events of sticking. All of the ridges show self-spreading behavior, i.e. lowering and broadening, and most of them start to slip in the middle of the lowering stage as star symbols indicate. In case the lowering stage is finished with no stick-to-slip transition (black circles), a ridge starts to heighten (orange arrow) by creep deformation. For the entire processes of the ridge development in sticking, the cusp geometry is unchanged.



Fig. S2. Growth of a wetting ridge in continuous-slipping. (a) Opposite tendency of the contact line velocity U and the ridge height H. (b) In continuous-slipping, the contact line (i.e. the triple point in the images) slides on the ridge side with making a new ridge successively.



Fig. S3. Schematic illustration of the continuous ridge migration. Assume that a contact line is pinned by a wetting ridge on a viscoelastic substrate at $\Delta t = t_0$. When it is depinned at $\Delta t = t_1$ (left), it slides down along the side of the ridge frozen in such a short time scale (as seen Fig. S2b) due to the viscoelastic properties of the substrate. Then, the contact line lifts the ridge side (red arrow at $\Delta t = t_1$ right) and a new ridge forms from the side ($u_z \neq 0 \mu m$, at $\Delta t = t_1$ left), which can cause gradual ridge growth during the continuous ridge migration (as seen in Fig. 1, a and c (bottom)). The ridge growth will be saturated at a steady state for a given U as shown at $\Delta t = t_2$.