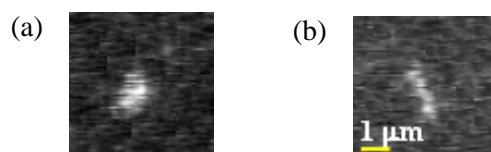


## Supplementary Data

The experiments presented in the main manuscript were carried out with  $\lambda$ DNA, a linear DNA. Here, using the same experimental procedures, simple manipulation of plasmids (circular DNAs) is presented.

Fig. S1 shows the restriction enzyme digestion of Escherichia coli plasmid (pBR322 from Takara, Japan) and the subsequent electrostretching of the cleaved fragment in a single microchamber. Length of pBR322 is 4361 bp. (a) Electrostretching of a single encapsulated plasmid, stretched length measured at 0.7  $\mu\text{m}$ . This is expected as circular DNA is covalently bonded at its ends to form an enclosed structure, unlike in the case of linear DNA where the ends are free. Therefore, the maximum possible full stretch would be approximately half of the theoretical length at 2180 bp or equivalent to 0.73  $\mu\text{m}$ ; (b) *BamH* I (Takara, Japan) digestion on pBR322, triggered by external application of  $\text{Mg}^{2+}$ . *BamH* I cleaves pBR322 once, hence the fragment is no longer enclosed, and becomes similar to a linear structure. By electrostretching the resultant cleaved plasmid, the length is directly measured at 1.3  $\mu\text{m}$ , which is equivalent to 3900 bp.



Captions for supplementary movies

Filename: Fig4b-mv

Sample solution contains  $\lambda$ DNA, 7% LPA and *NheI*. Microelectrodes for electrostretching are positioned on the left and right, across the image.

00:00:00-00:00:01  $\text{MgCl}_2$  is applied to the exterior of the PAA gel and  $\text{Mg}^{2+}$  ions begin to diffuse through the gel matrix into the microchamber, encapsulating a single  $\lambda$ DNA molecule.

00:00:02-00:00:03 Digestion occurs after 6 mins.

00:00:04-00:00:10 Alternating field is applied to stretch the freely-suspended fragments after completing restriction enzyme reaction.

Filename: Fig4c-mv

Sample solution contains  $\lambda$ DNA, 7% LPA and *PmeI*. Microelectrodes for electrostretching are positioned at the top and bottom, across the image.

00:00:00-00:00:02  $\text{MgCl}_2$  is applied to the exterior of the PAA gel and  $\text{Mg}^{2+}$  ions begin to diffuse through the gel matrix into the microchamber, encapsulating a single  $\lambda$ DNA molecule.

00:00:03-00:00:04 First cut (digestion) occurs after 6 mins.

00:00:05-00:00:07 Second cut (digestion) occurs after 9 mins.

00:00:07-00:00:10 Alternating field is applied to stretch the freely-suspended fragments after completing restriction enzyme reaction.

Filename: Fig5-mv

Sample solution contains  $\lambda$ DNA, 7% LPA and *BamHI*. Microelectrodes for electrostretching are positioned at the top and bottom, across the image.

00:00:00-00:00:03 Microchamber containing six fragments resulted from digesting a single encapsulated  $\lambda$ DNA molecule with *BamHI*.

00:00:04-00:00:10 Alternating field is applied to stretch the freely-suspended fragments.