Supplementary Information (SI) to accompany

Transport of microtubules according to the number and spacing of kinesin motors on gold nano-pillars

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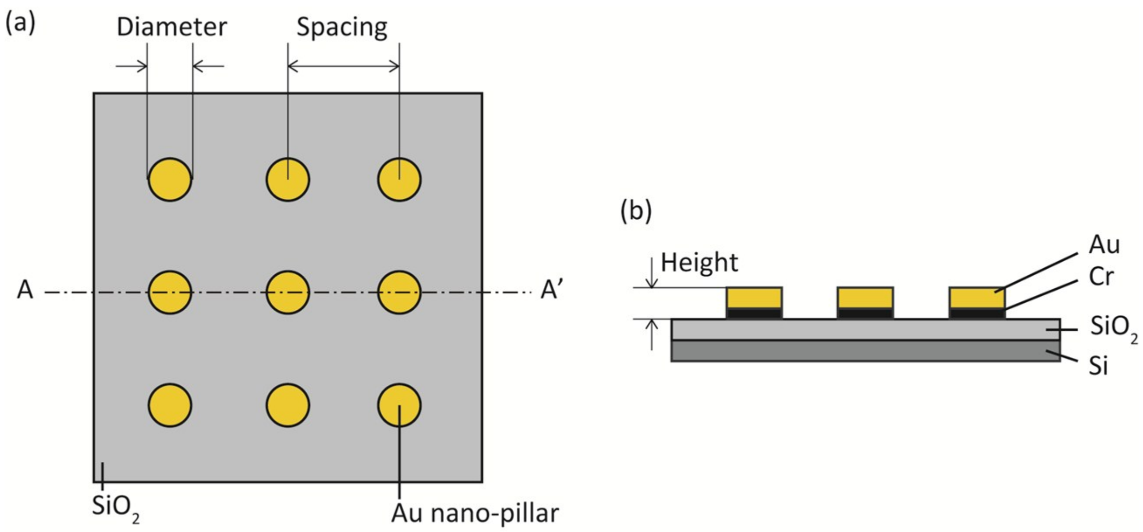
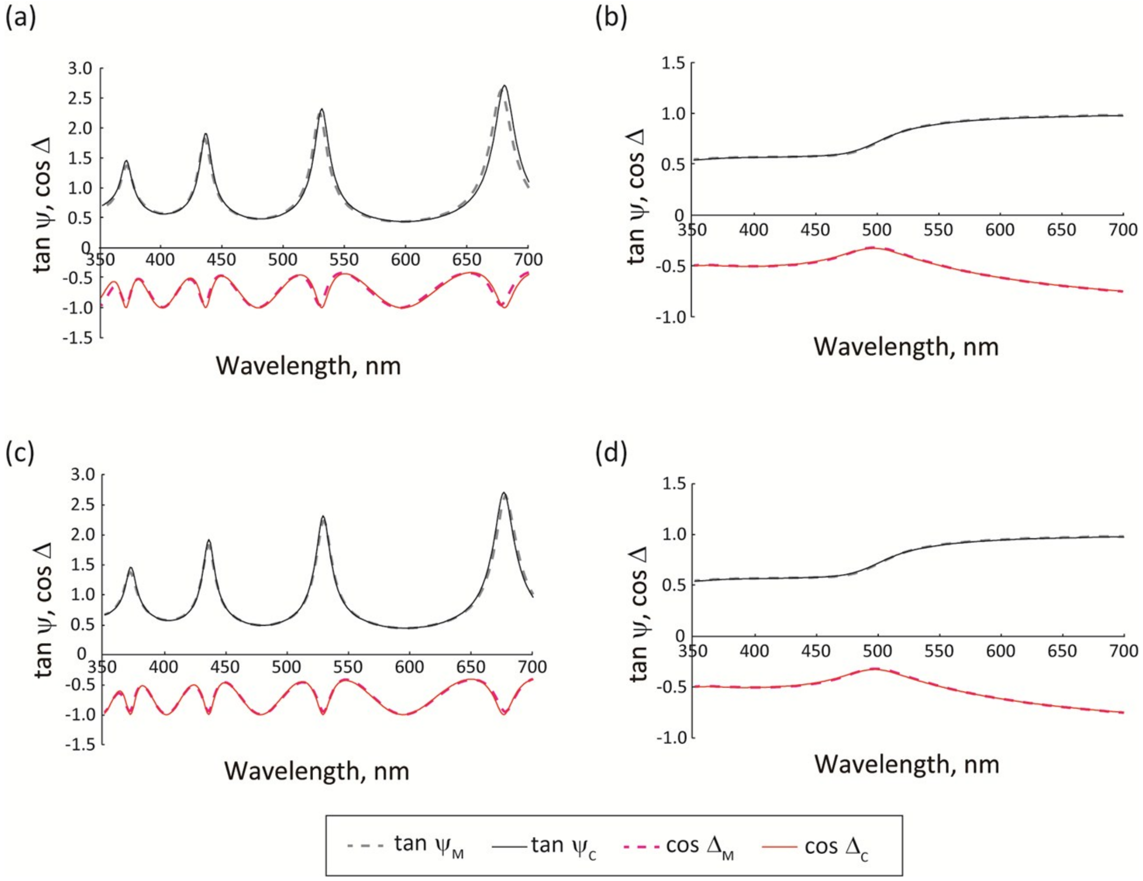
Contents

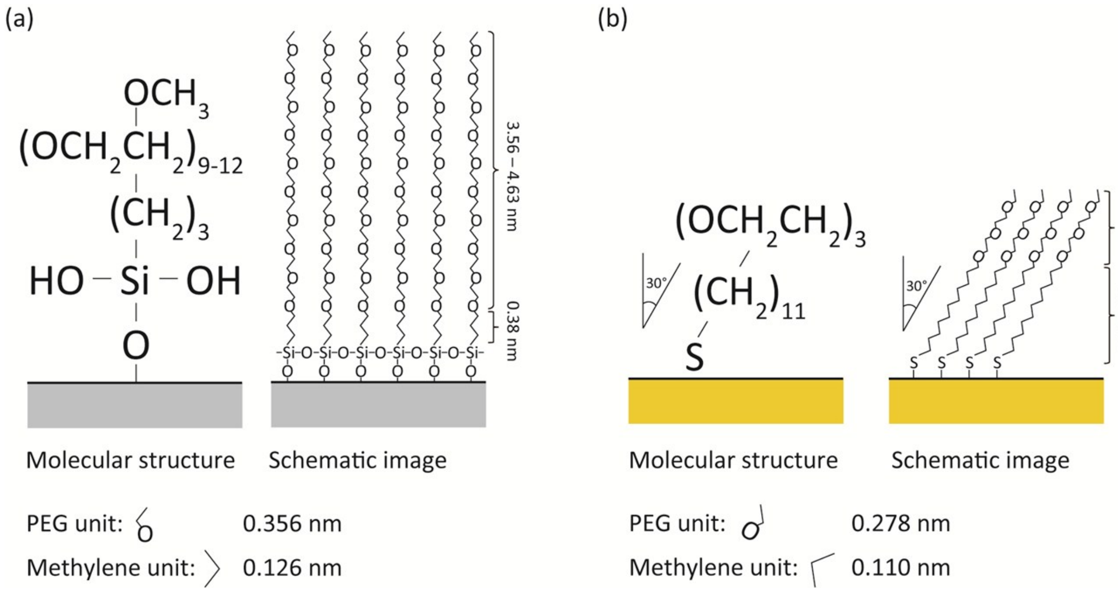
1. Supplementary figures



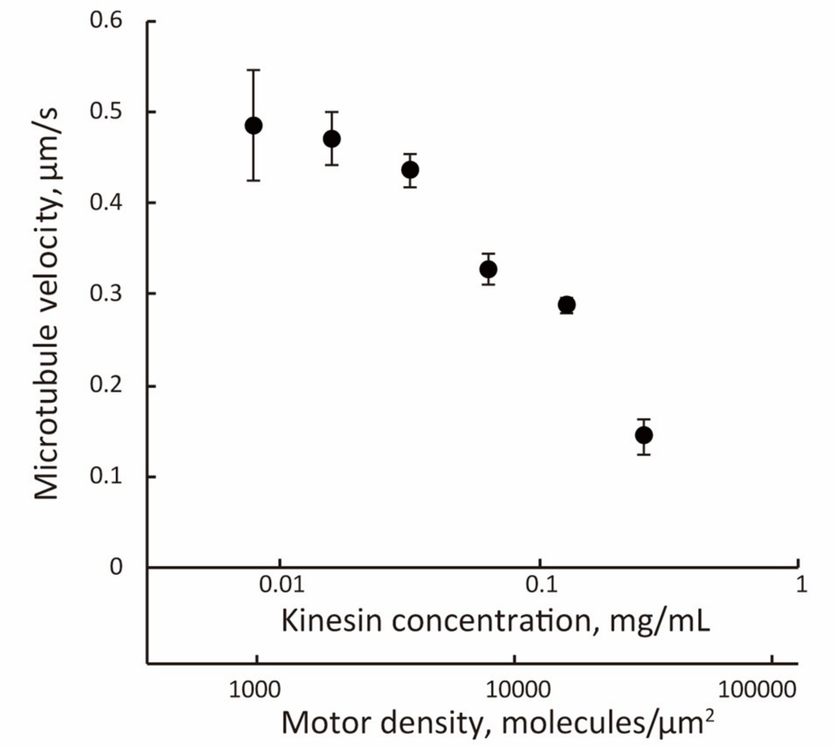
Supplementary Figure S1 | Design of Au nano-pillars. (a) Top view. (b) Cross sectional view.



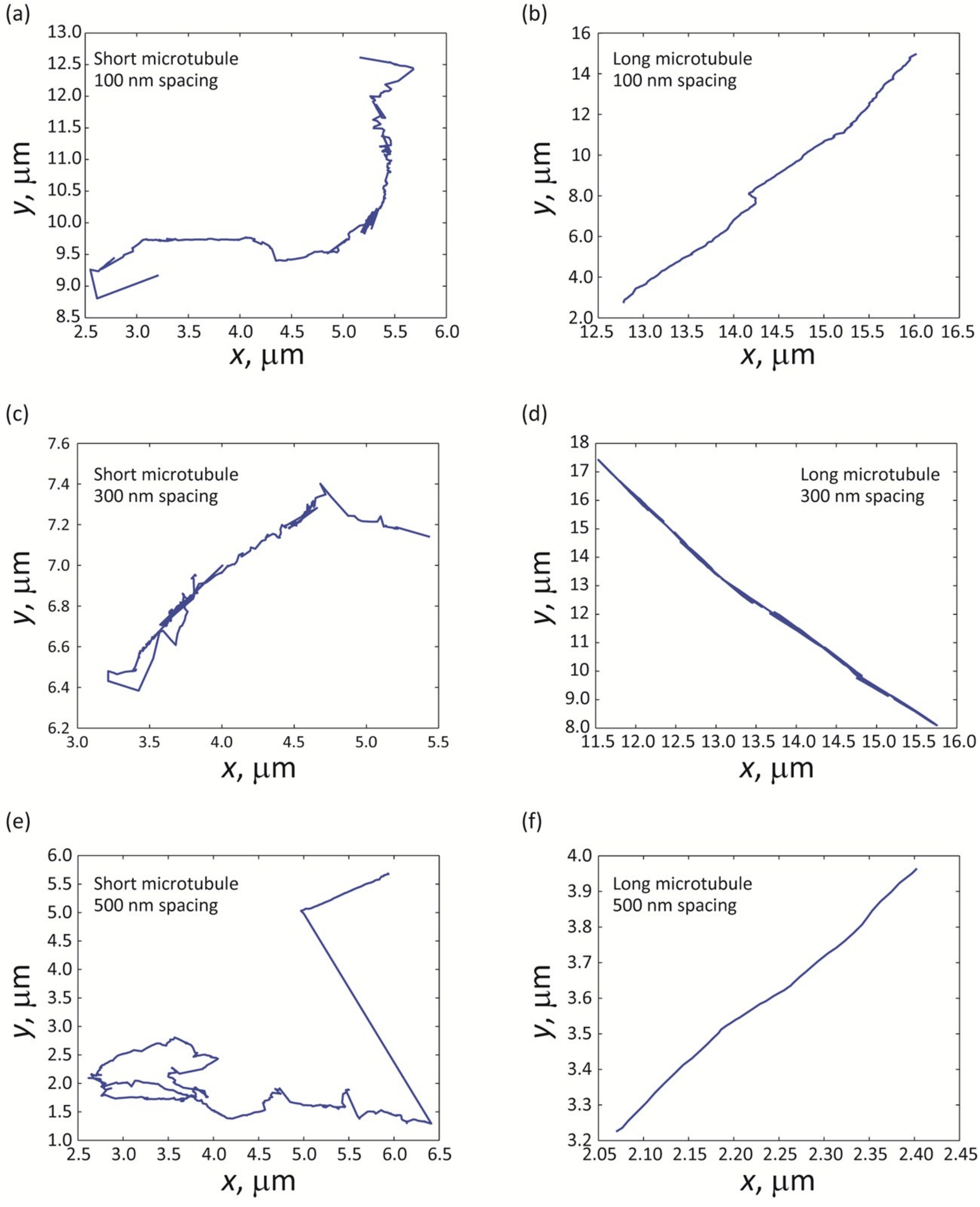
Supplementary Figure S2 | Spectral data of SAM obtained by ellipsometry. (a) Silane-PEG-CH_3 SAM on the SiO_2 surface treated with the silane-PEG-CH_3 solution. (b) Thiol-PEG-biotin SAM on the Au surface treated with the thiol-PEG-biotin solution. (c) Silane-PEG-CH_3 SAM on the SiO_2 surfaces treated with the mixed SAM solution. (d) Thiol-PEG-biotin SAM on the Au surface treated with the mixed SAM solution.



Supplementary Figure S3 | Thickness of SAMs. (**a**) Structure of silane-PEG-CH_3 SAM. The expected SAM thickness was calculated as 3.9–5.0 nm. (**b**) Structure of thiol-PEG-biotin SAM. The expected SAM thickness was calculated as 2.05 nm.



Supplementary Figure S4 | Dependency of the microtubule gliding velocity on the concentration and density of AviTag-K465. Motor density was estimated from the concentration of AviTag-K465. We assumed all kinesin molecules introduced into a flow cell were immobilized on the surface. Mean ± S.D.; N > 20.



Supplementary Figure S5 | Trajectories of short and long microtubules on Au nano-pillars. The trajectories of short microtubules (L = 2.28 ± 0.99 μm) on nano-pillars with (a) 100 nm, (c) 300 nm, and (e) 500 nm spacings. Trajectories of long microtubules (>10 μm) on nano-pillars with (b) 100 nm, (d) 300 nm, and (f) 500 nm spacings.

2. Supplementary table

Supplementary Table S1 | Design of nano-pillars.

Pattern	Diameter, nm	Spacing, nm	Height, nm
1	50	100	100
2	100	300	100
3	100	400	100

Supplementary Table S2 | Values of parameters used in the numerical simulation.

Parameter	Symbol	Values	Note, reference
Dynamic viscosity of buffer	η	0.0045 Pa·s	The value of 40 v/v% glycerol.
Distance between microtubule and surface	h_{MT}	15 nm	[1]
Compliance of kinesin spring	κ_{s}	0.2 pN/nm	[2–4]
Rest length of kinesin spring	l_0	40 nm	[2–4]
Unload velocity of kinesin	v_0	45.4 nm/s	
Stall force of kinesin	F_{s}	7 pN	[5,6]
Detachment rate of kinesin	k_{off}	$0.79e^{-\frac{F}{6.1}}\ (F < 0)$ $0.79 + 1.59F\ (F > 0)$	F is the load on kinesin's motor head. $F > 0$ means F is in the same direction as kinesin's step[7].

3. Supplementary references

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(3) Driver, J. W.; Jamison, D. K.; Uppulury, K.; Rogers, A. R.; Kolomeisky, A. B.; Diehl, M. R. Productive Cooperation among Processive Motors Depends Inversely on Their Mechanochemical Efficiency. *Biophys. J.* **2011**, *101*, 386–395.

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(5) Carter, N. J.; Cross, R. A. Mechanics of the Kinesin Step. *Nature* **2005**, *435*, 308–312.

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(7) Arpağ, G.; Shastry, S.; Hancock, W. O.; Tüzel, E. Transport by Populations of Fast and Slow Kinesins Uncovers Novel Family-Dependent Motor Characteristics Important for *in vivo* Function. *Biophys. J.* **2014**, *107*, 1896–1904.