SUPPORTING INFORMATION

Progress Towards Light-Harvesting Self-Electrophoretic Motors: Highly Efficient Bimetallic Nanomotors and Micropumps in Halogen Media

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Supporting Video SV1.

Video showing directionality of nanorods with silver as the leading end (Reflectance mode video) in 7.5% I_2 (42.3 μM I_2) and ambient lighting. For better visualization Au was used in place of Pt

Supporting Video SV2.

Video of nanorods in iodine (Transmission mode video) in 5% I_2 (28 μM I_2) and ambient lighting.

Supporting Video SV3.

Control video of Ag-Polymer nanorods in iodine fuel in 7.5% I_2 (42.3 μM I_2) and ambient lighting.

Supporting Video SV4.

AgPt nanorods in 7.5% I_2 (42.3 μM I_2), under red longpass filter.

Supporting Video SV5.

AgPt nanorods in 7.5% I_2 (42.3 μM I_2) from SV6, showing further motion after increase in light intensity at 25 s into the video.

Supporting Video SV6.

AgPt pump with sPSL tracers in 15% I_2 (85 μM I_2) in high light exposure.

Supporting Video SV7.

AgPt pump with aPSL tracers in 15% I_2 (85 μM I_2) in high light exposure.

Efficiency Calculation for Ag-Pt/I_2 System

$$\eta_{ambient} = \frac{P_{mech}}{P_{chem}} = 1.34 \times 10^{-5}$$

Reaction:

$I_2 + e^- \rightarrow 2I^-$ $E^0 = 0.535\ V$

$Ag + I^- \rightarrow AgI + e^-$ $E^0 = 0.152\ V$

$E^0_{cell} = 0.687\ V$

$E_{cell\ (measured)} = 0.66V$

Mechanical Power Output (P_{mech}):

$$P_{mech} = F_{drag}v = fv^2$$

$$f = \frac{2\pi\mu L}{ln\left(\frac{2L}{R}\right) - 0.72}$$

μ = *dynamic viscosity of water* (1×10^{-3} *Ns/m*)
L = *length of cylinder* (3×10^{-6} *m*)
R = *radius of cylinder* (150×10^{-9} *m*)

$$f = \frac{2\pi(1 \times 10^{-3}\ Ns/m^2)(3 \times 10^{-6}\ m)}{ln\left(\frac{2 \times 3 \times 10^{-6}\ m}{150 \times 10^{-9}\ m}\right) - 0.72} = 8.28 \times 10^{-9}\ Ns/m$$

$$v^2{}_{ambient} = (20 \times 10^{-6}\ m/s)^2 = 4 \times 10^{-10}\ (m/s)^2$$

Chemical Power Input (P_{chem}):

$$P_{chem} = n_{I_2}\Delta G$$

$$n_{I_2} = \frac{n_{fuel}}{m_{rods} \times t_{rxn}}$$

n_{I_2} = *rate of fuel consumption (mol/s for each nanorod)*
ΔG = *Gibbs free energy for halide conversion per mol of* I_2
m_{rods} = *number of rods in system*
t_{rxn} = *reaction time (assuming instantaneous reaction,* t_{rxn} = *1 second)*

$$n_{fuel} = 1.13 \times 10^{-9}\ mol\ I_2$$

$$m_{rods} = \frac{10^9\ rods}{cm^2} \times 0.3167\ cm^2 \times \frac{1}{4}\ dilution\ factor$$

$$= 7.9 \times 10^7 \frac{rods}{sample\ vol\ 1\ mL} \times 10^{-3}\ mL\ sample\ size = 7.9 \times 10^5\ rods$$

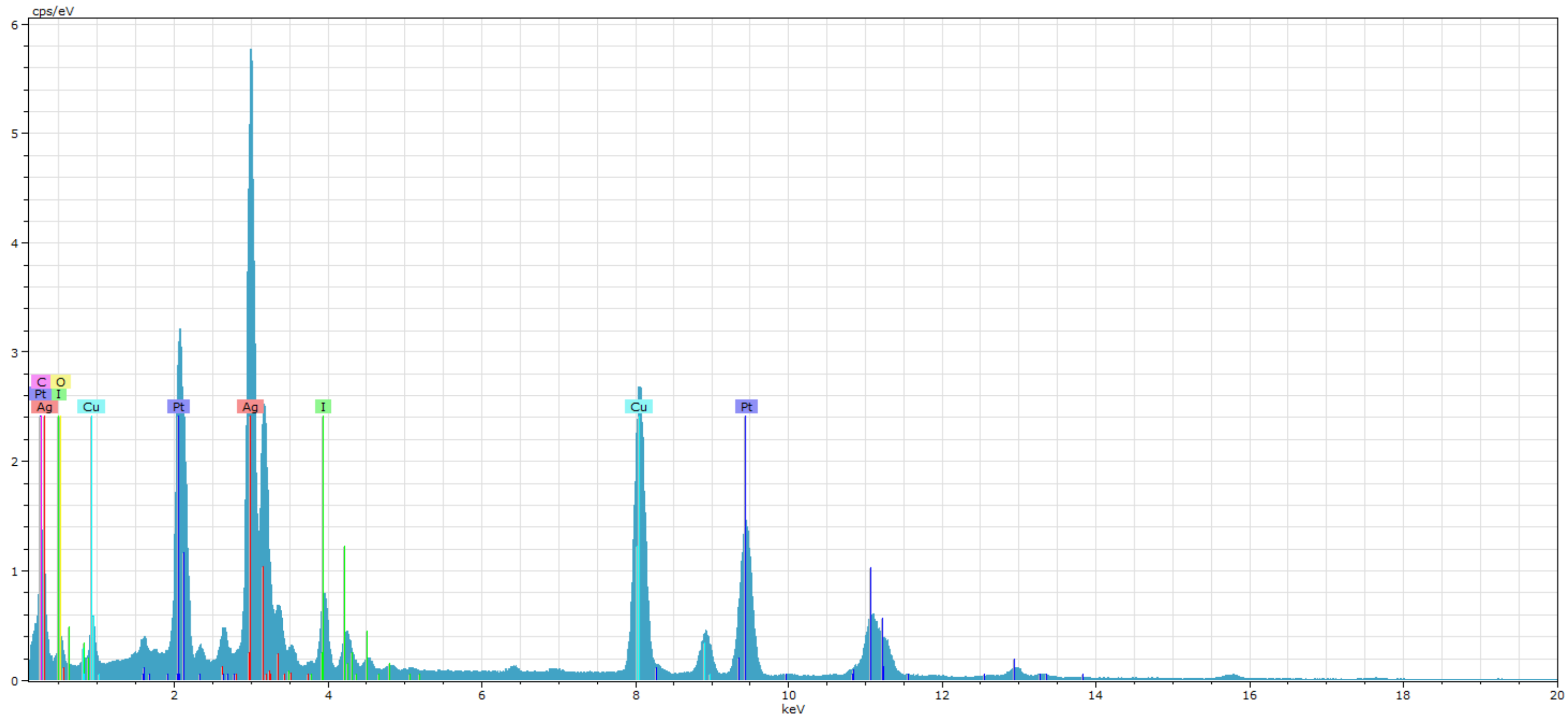
$$\Delta G = -nFE^0_{cell}$$

$$\Delta G = -(2\ mol\ e^-)\left(94687\frac{C}{mol}e^-\right)(0.687\ V) = 1.325x\ 10^5\ J = 1.325\ \times\ 10^2\ kJ/mol\ I_2$$

$$P_{chem} = n_{I_2}\Delta G = 2.85\ \times\ 10^{-17}\frac{mol}{s}\ \times\ 1.325x\ 10^2\ kJ/mol = 3.784\ x\ 10^{-15}\frac{kJ}{s}$$

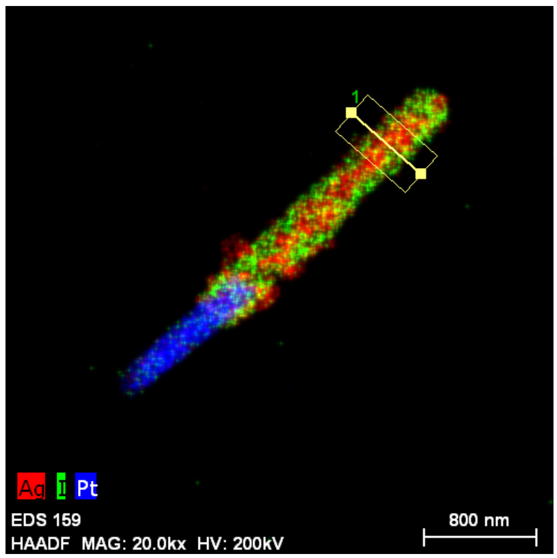
Supporting Figure SF1.

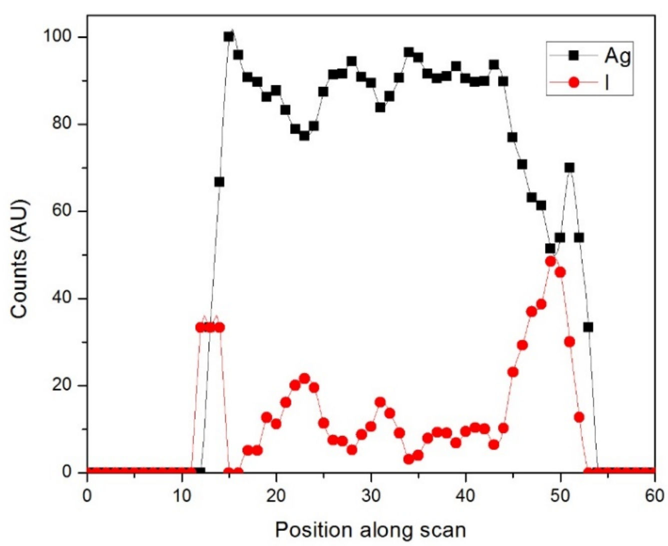
Typical spectrum obtained from elemental mapping data of AgI-Pt nanorod using Titan EDS. EDS data was taken at 80 kV on a Titan TEM. Cu arises from the use of a copper TEM grid.



Supporting Figure SF2.

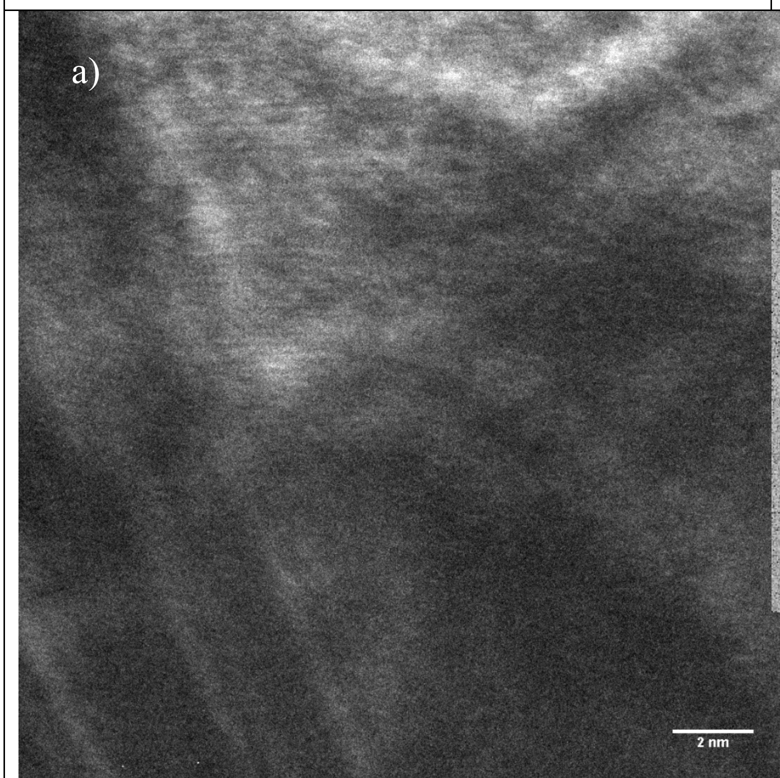
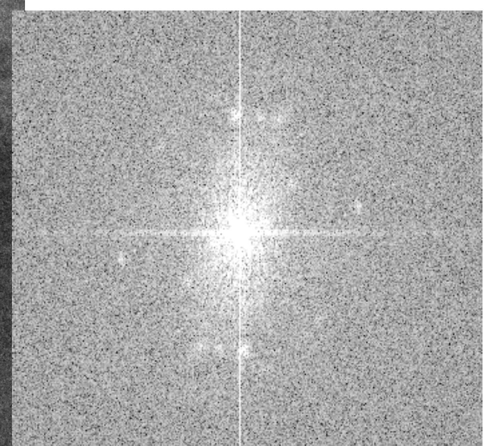
Elemental mapping scan data of AgI-Pt nanorod using Titan EDS. Top image shows the path of the scan across the silver segment. The bottom image is the graph generated from the counts detected for the elements silver and iodine.

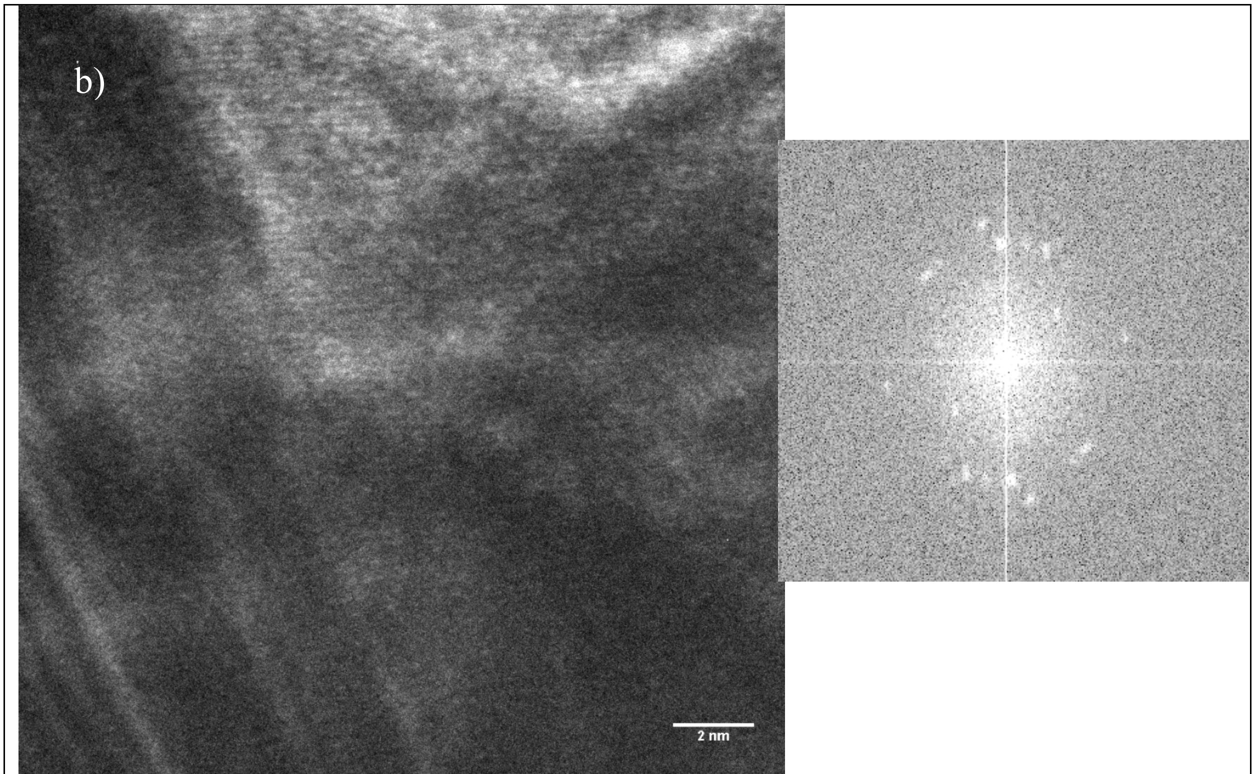


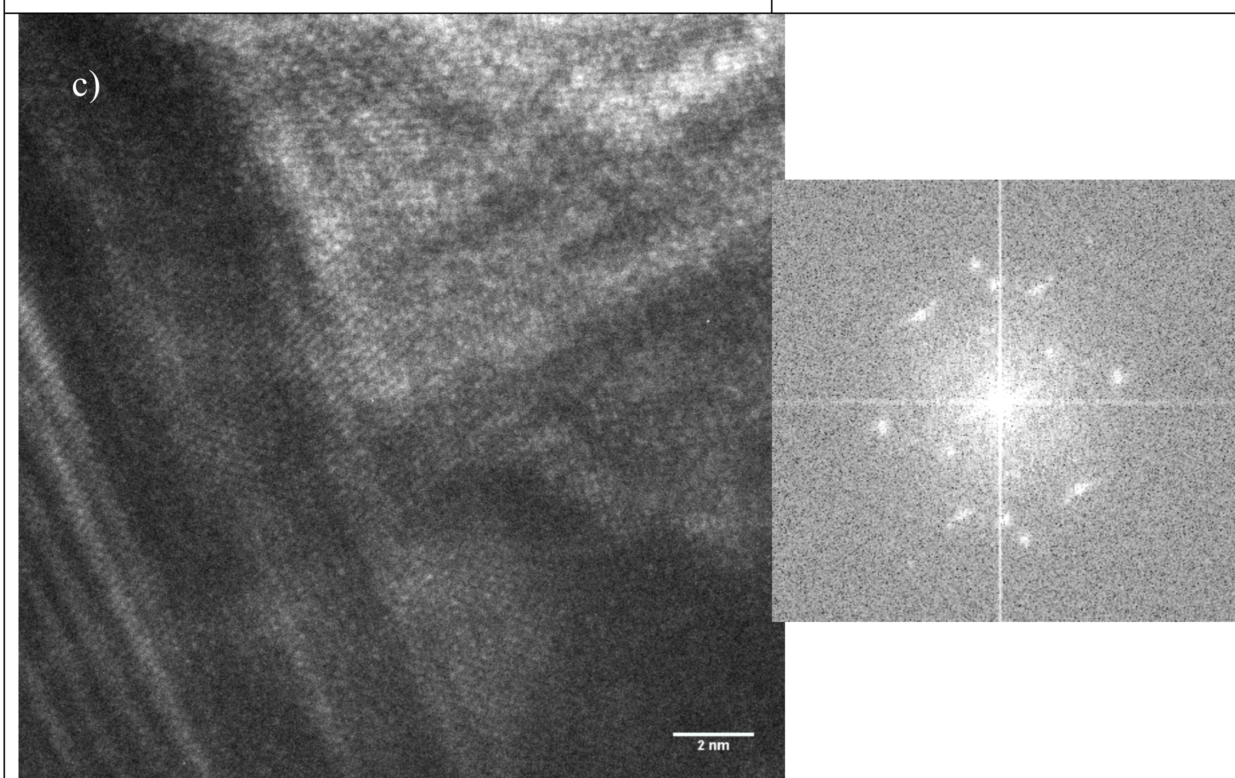


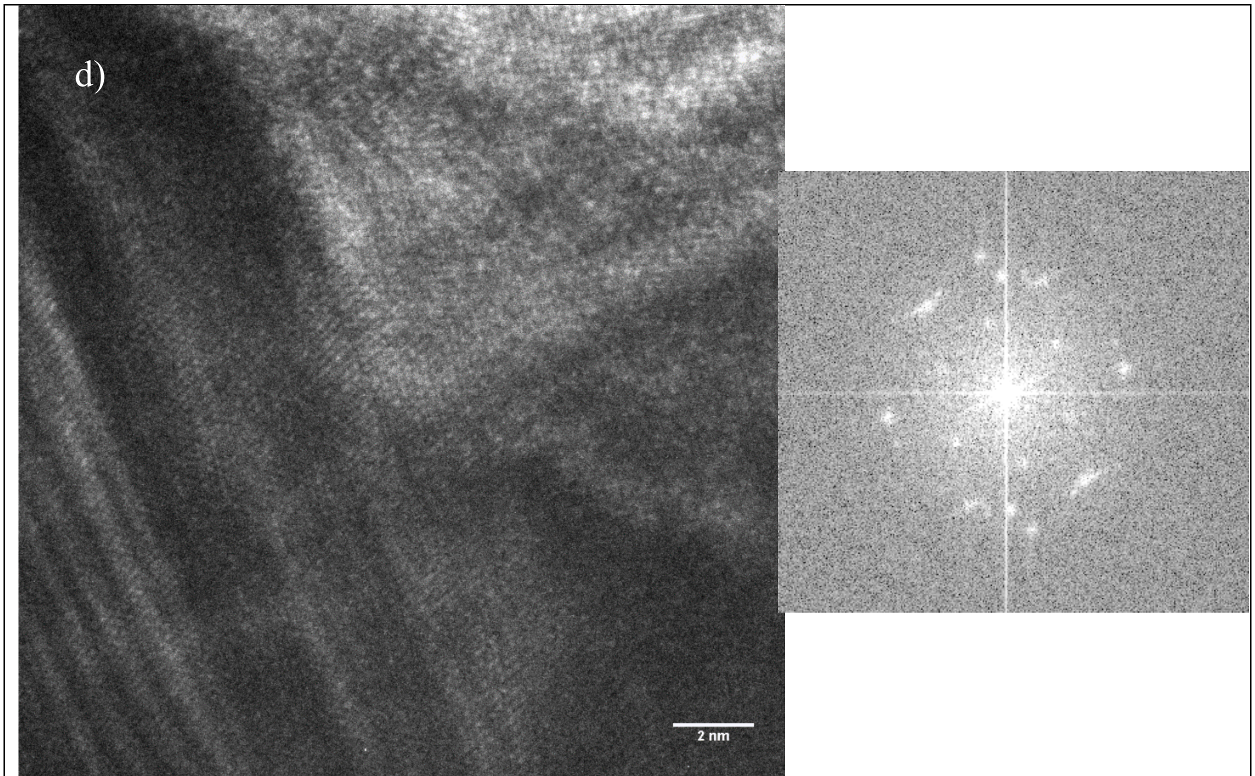
Supporting Figure SF3.

HRTEM (with FFT) images of edge of AgI converted nanomotors taken in sequence (a-d) at 200 kV at the same location and focus over 5 sec, showing formation of crystalline material over time.

HRTEM Image	**FFT**
	

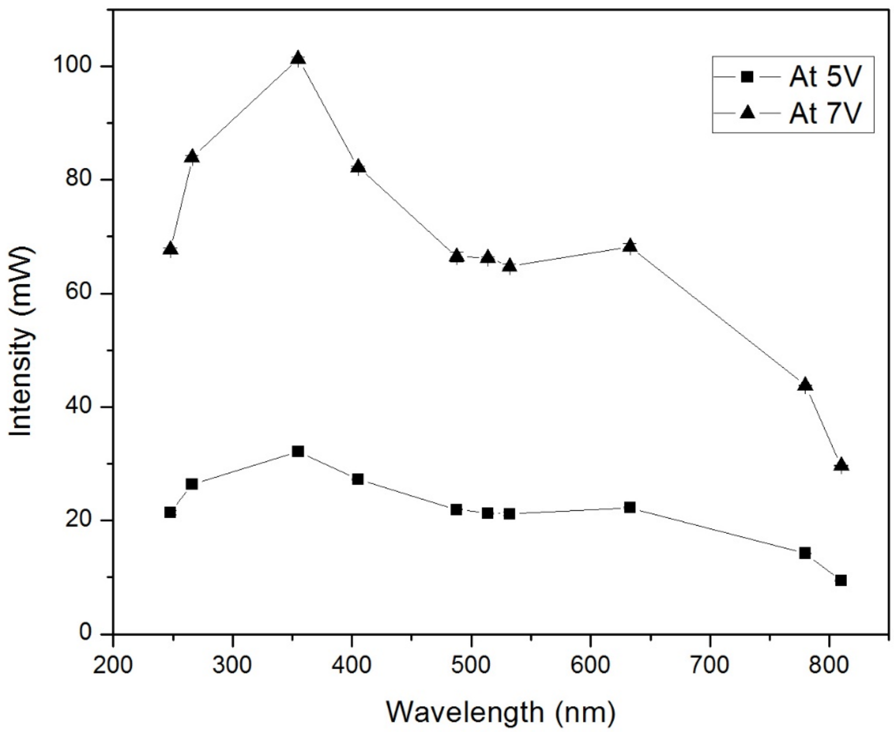

b)
2 nm


c)
2 nm


d)
2 nm

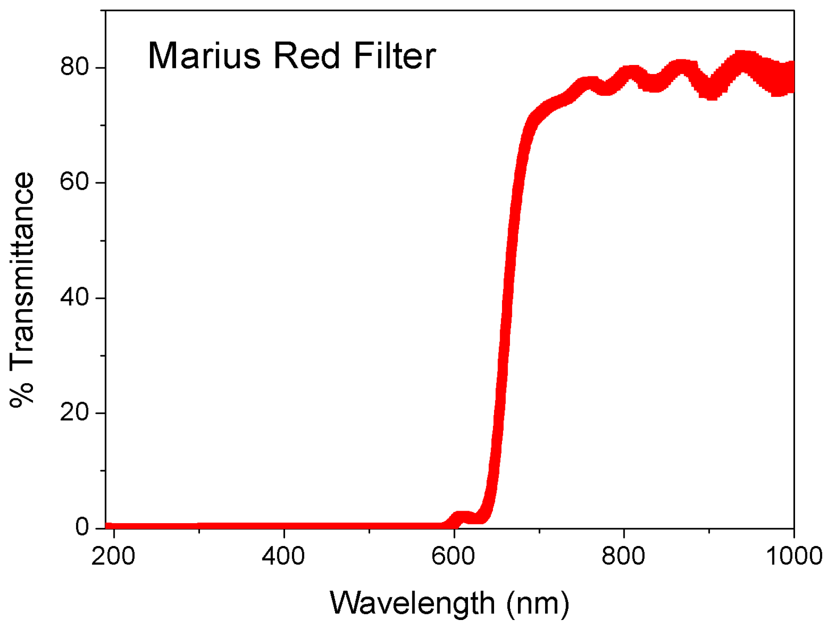
Supporting Figure SF4.

Lamp intensity readings at 5V (reported as 20 mW intensity) and 7V (reported as 80 mW intensity) microscope settings.



Supporting Figure SF5.

Transmittance spectrum of commercial red longpass filter (purchased from LEE filters, Marius Red), taken on a Thermo Fisher Evolution 220 UV-Visible Spectrophotometer.



Supporting Figure SF6.

Microscope image showing the curling of nanomotors when exposed to high UV intensity in presence of 112 μM iodine.