Supporting Information

Peptide-mediated nanopore detection of uranyl ions in aqueous media

Golbarg M Roozbahani[1], Xiaohan Chen[1], Youwen Zhang[1], Ruiqi Xie[1], Rui Ma[1], Dien Li[2], Huazhong Li[3], and Xiyun Guan[1,*]

[1]Department of Chemistry, Illinois Institute of Technology, 3101 S Dearborn St, Chicago, IL 60616, USA

[2]Environmental Sciences and Biotechnology, Savannah River National Laboratory, Aiken, SC 29808, USA

[3]Henan Jintai Biological Technology Co., Ltd., ZhengZhou, Henan, PR China

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Table S1. Effect of buffer solution on peptide translocation in the nanopore. The experiments were performed at +80 mV with the $(M113F)_7$ αHL protein nanopore in electrolyte solutions with different pH values and different buffer components. The concentration of peptide HH_{14} was 10 μM.

Buffer components	Buffer pH	Event counts / min
1 M NaCl, 10 mM sodium phosphate	4.5	6.0
	5.5	6.7
1 M NaCl, 10 mM sodium acetate	4.5	3.4
	5.5	5.0
1 M NaCl, 10 mM sodium citrate	4.5	2.1
	5.5	2.6
1 M NaCl, 10 mM Tris	6.5	42.5
	7.5	61.7

Table S2. The net charges* of peptide HH_{14} at different pH values.

pH	Histidine	Lysine	Tyrosine	Peptide HH_{14}
7.5	0.01	0.98	-0.03	1.05
6.5	0.25	1.00	0.00	4.05
5.5	0.78	1.00	0.00	10.31
4.5	0.97	1.00	0.01	12.69

*The net charge of peptide HH_{14} (sequence: HHHHHHKHHHYHHH) at each pH value was determined by amino acid composition, i.e., the sum of the net charges of all the amino acids in the peptide. The net charge (*Z)* of an amino acid was estimated by using the equation:

$$Z = \sum_i N_i \frac{10^{pK_{ai}}}{10^{pH} + 10^{pK_{ai}}} - \sum_j N_j \frac{10^{pH}}{10^{pH} + 10^{pK_{aj}}}$$

Where the pK_a values pertain to the N-terminus and the side chains of lysine and histidine, and the *j*-index belongs to the C-terminus and tyrosine amino acid.

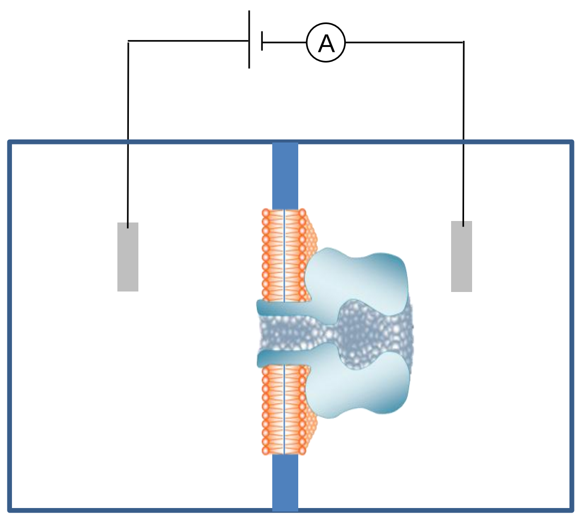

Figure S1. Schematic illustration of the uranyl nanopore sensor.

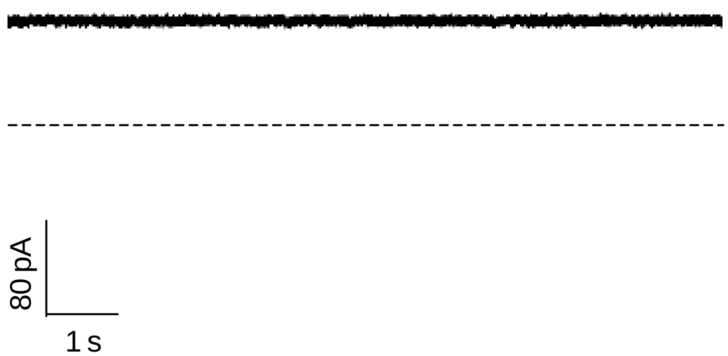

Figure S2. Typical single-channel recording trace segment, showing that uranyl ions didn't produce any current blockage events in the nanopore. The experiment was performed at +100 mV with the $(M113F)_7$ αHL protein pore in an electrolyte solution comprising 1.0 M NaCl and 10 mM Tris•HCl (pH 6.5) and in the presence of 10 μM uranyl ions. The dashed line represents the level of zero current.

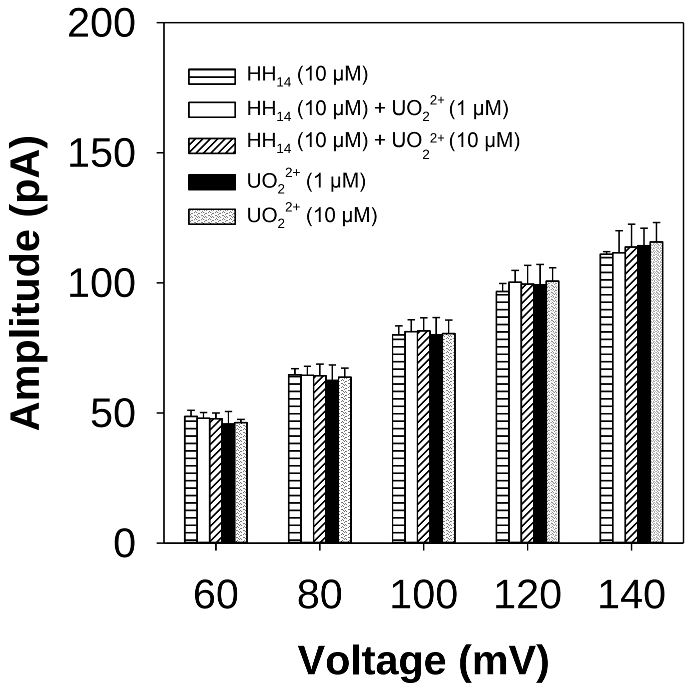

Figure S3. I-V Curves of peptide HH_{14}, UO_2^{2+}, and their mixtures in the nanopore. The experiments were performed with the $(M113F)_7$ αHL protein pore in an electrolyte solution comprising 1.0 M NaCl and 10 mM Tris•HCl (pH 6.5).

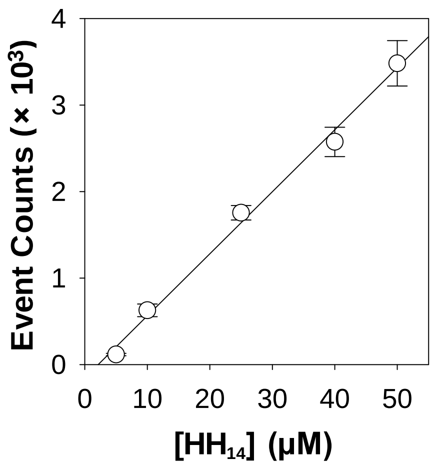

Figure S4. Dose response curve for peptide HH_{14}. The experiments were performed at +100 mV with the $(M113F)_7$ αHL protein pore in an electrolyte solution containing 1 M NaCl and 10 mM Tris (pH 6.5). Event counts were calculated based on 10-min single channel recording trace segments.

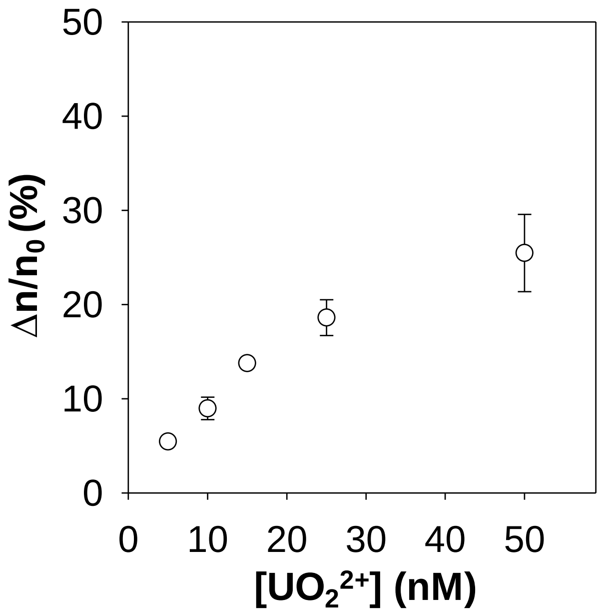

Figure S5. Dose-response curve for uranyl in asymmetric electrolyte conditions (3 M NaCl and 10 mM Tris•HCl (pH 6.5) (*cis*) / 0.5 M NaCl and 10 mM Tris•HCl (pH 6.5) (*trans*)). The experiments were performed at +100 mV with the $(M113F)_7$ αHL nanopore in the presence of 10 μM peptide HH_{14}, which was added to the *trans* compartment of the nanopore sensing chamber. The change (Δn) in the number of peptide HH_{14} events after addition of UO_2^{2+} to the solution was calculated by using the equation: $\Delta n = n_0 - n_1$, where n_0 represented the number of HH_{14} events in the absence of uranyl, while n_1 depicted the number of peptide HH_{14} events in the presence of UO_2^{2+}.

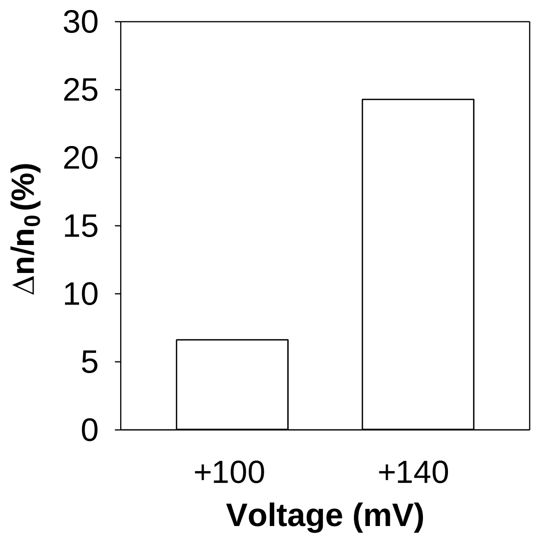

Figure S6. Voltage effect on the sensitivity of the nanopore uranyl sensor. The experiments were performed with the $(M113F)_7$ αHL nanopore in the presence of 10 μM peptide HH_{14} and 5 nM UO_2^{2+} under a salt gradient condition of 3 M NaCl and 10 mM Tris•HCl (pH 6.5) (*cis*) / 0.5 M NaCl and 10 mM Tris•HCl (pH 6.5) (*trans*). The change (Δn) in the number of peptide HH_{14} events after addition of UO_2^{2+} to the solution was calculated by using the equation: $\Delta n = n_0 - n_1$, where n_0 represented the number of HH_{14} events in the absence of uranyl, while n_1 depicted the number of peptide HH_{14} events in the presence of UO_2^{2+}.