Online supporting information

Enabling an atom-economic green production of chiral amino alcohols by electrodialysis with bipolar membranes

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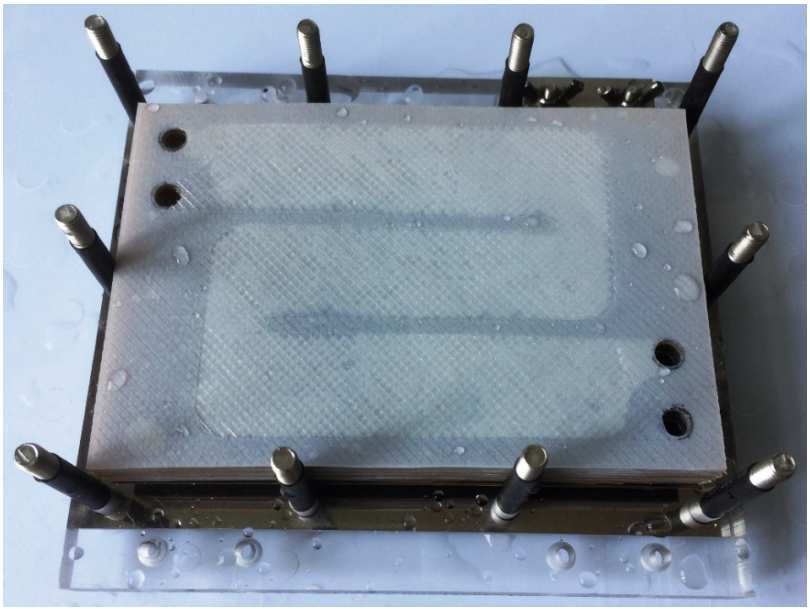

Fig. S1 Inner photograph of the EDBM stack, which shows a home-made spacer with the tortuous flow path.

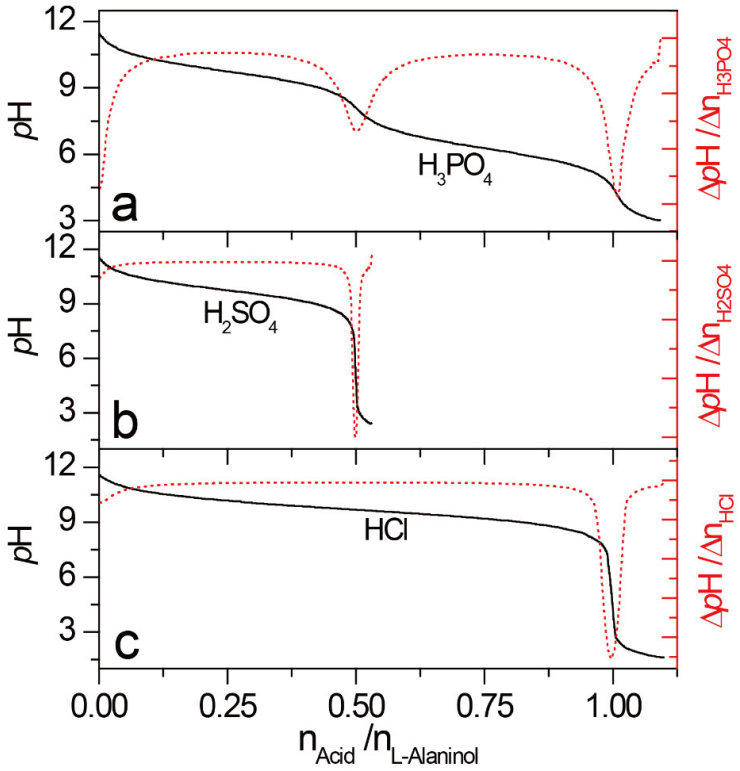

Fig. S2 Typical potentiometeric titration curves of L-Alaninols with acid solutions, including (a) H_3PO_4, (b) H_2SO_4 and (c) HCl standrad solutions. The volume of the acid solution has been normalized as the mole of acid consumed per mole of L-Alaninol.

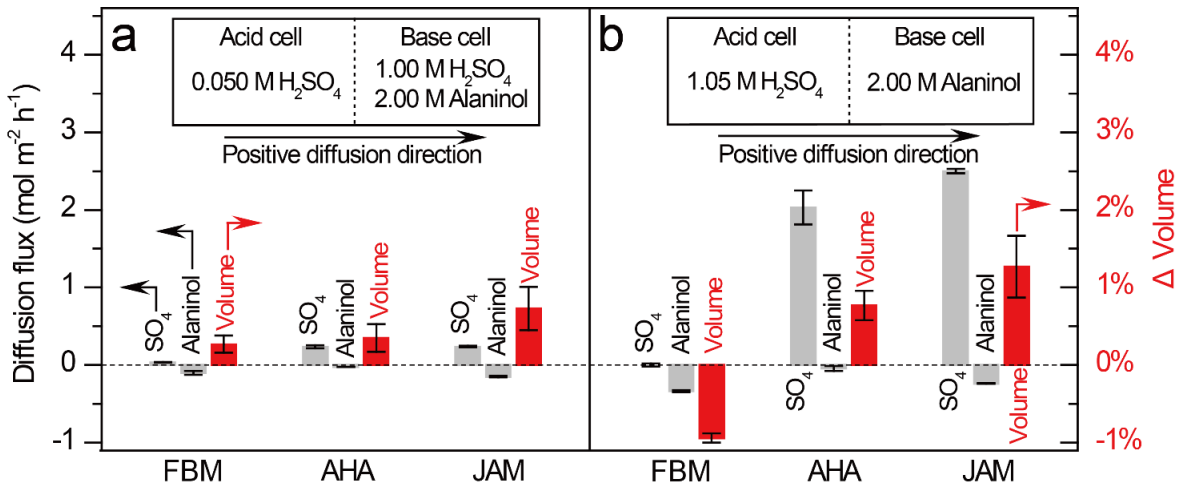

Fig. S3 Diffusion fluxes of various membranes in different solutions with H_2SO_4 and L-Alaninol. (a) In the initial stage. (b) In the final stage of EDBM process.

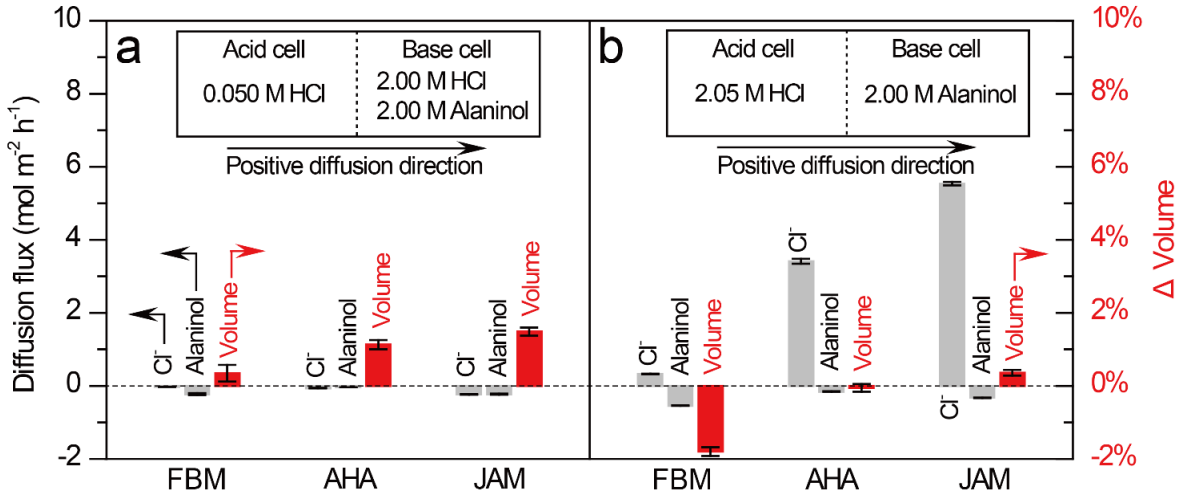

Fig. S4 Diffusion fluxes of various membranes in different solutions with HCl and L-Alaninol. (a) In the initial stage. (b) In the final stage of EDBM process.

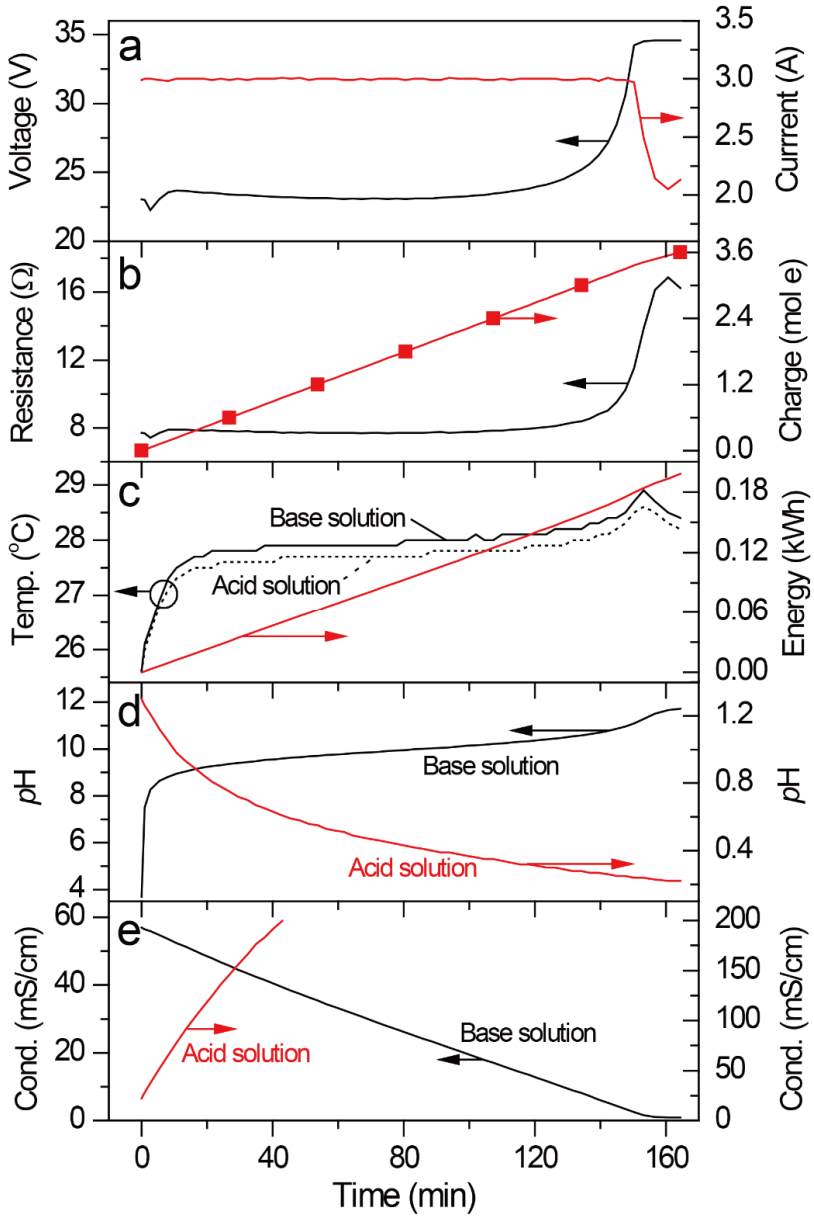

Fig. S5 Online data profiles of the EDBM process with L-Alaninol sulfate solution. (a) Stack voltage and current curves. (b) Stack resistance and charge transferred. (c) The temperature and the EDBM energy consumption curves. (d) The pH variations of both acid and base solutions. (e) The conductivity curves of both acid and base solutions. The conductivity of acid solution exceeds the upper limit (200 mS/cm) of the instrument after 43 min.

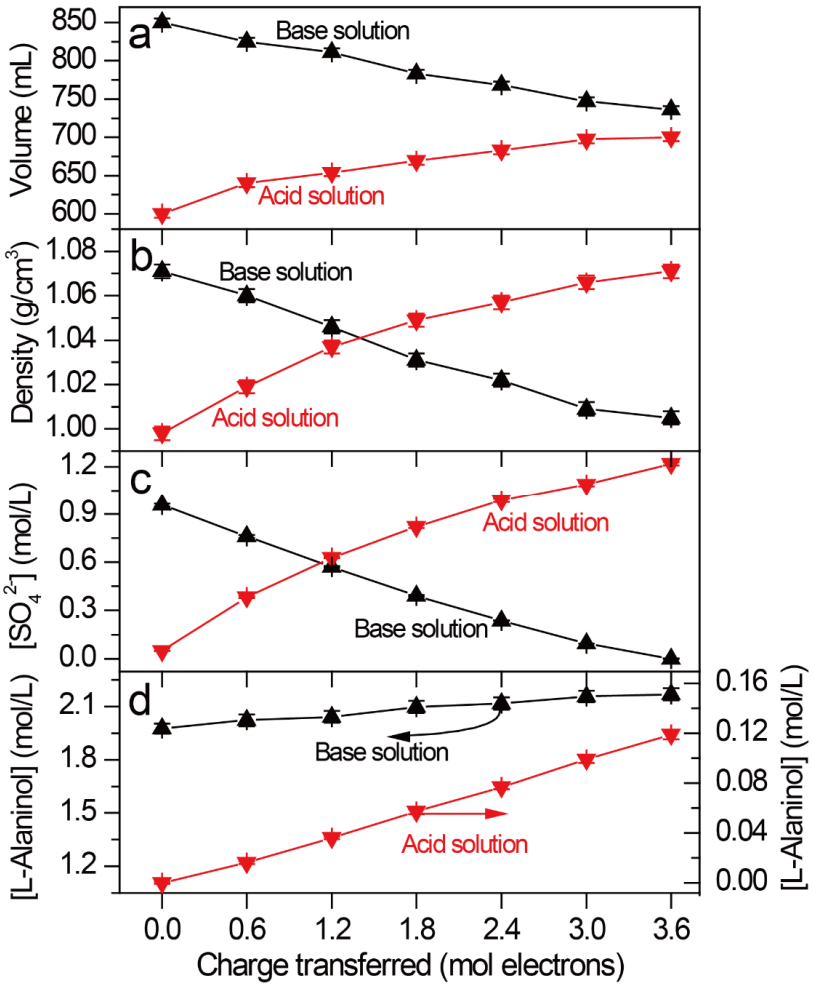

Fig. S6 Offline sample analysis results during the EDBM process with L-Alaninol sulfate solution. (a) Volume variations of acid and base solutions. (b) Density variations of acid and base solutions. (c) Concentration of total P variations of acid and base solutions. (d) Concentration of L-Alaninol variations of acid and base solutions.

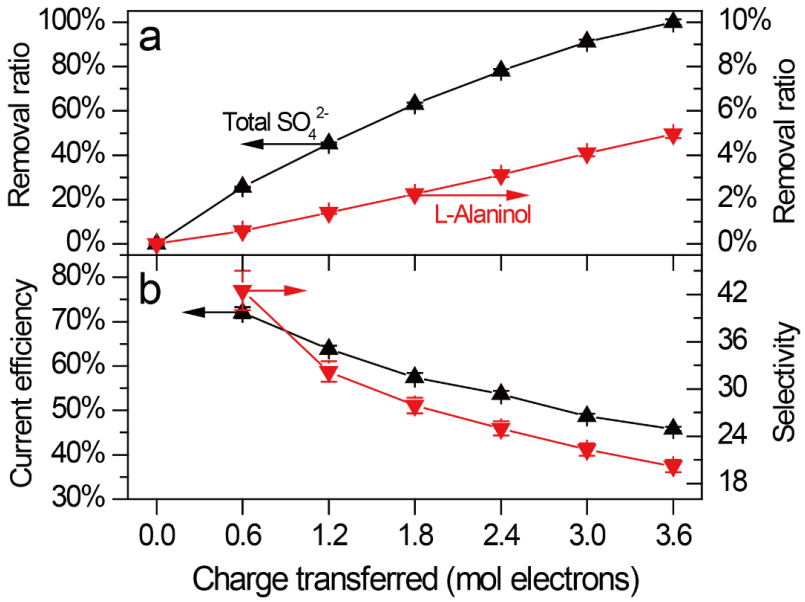

Fig. S7 (a) The removal ratio of total sulfate and L-Alaninol. (b) The corresponding permselectivity of total sulfate over L-Alaninol, as well as the cumulative current efficiencies.

Table S1. Cost estimation of the EDBM process with L-Alaninol sulfate.

Items			Notes
Capital cost			
Area of AEM	0.072	m^2	
Area of BP	0.072	m^2	
Price of AEMs	360	$/$m^2$	
BP-Price	720	$/$m^2$	
Membrane cost	77.76	$	
Stack cost	116.64	$	*1.5 times of membrane*
Peripheral equipment cost	58.32	$	*0.5 times of stack*
Total capital cost	174.96	$	
Operational cost			
Energy	0.198	kWh	
Batch time	164	min	
Product concentration	2.17	mol/L	
Product volume	736	mL	
Batch productivity	1.597	mol	
Overall cost			
System lifespan	16000	h	*2-year estimation*
Total productivity	700.5	kg	*As pure L-Alaninol*
Capital cost	0.250	$/kg	
Energy	1.65	kWh/kg	
	0.165	$/kg	*$0.10/kWh power price*
Total cost	0.415	$/kg	*Capital + energy*

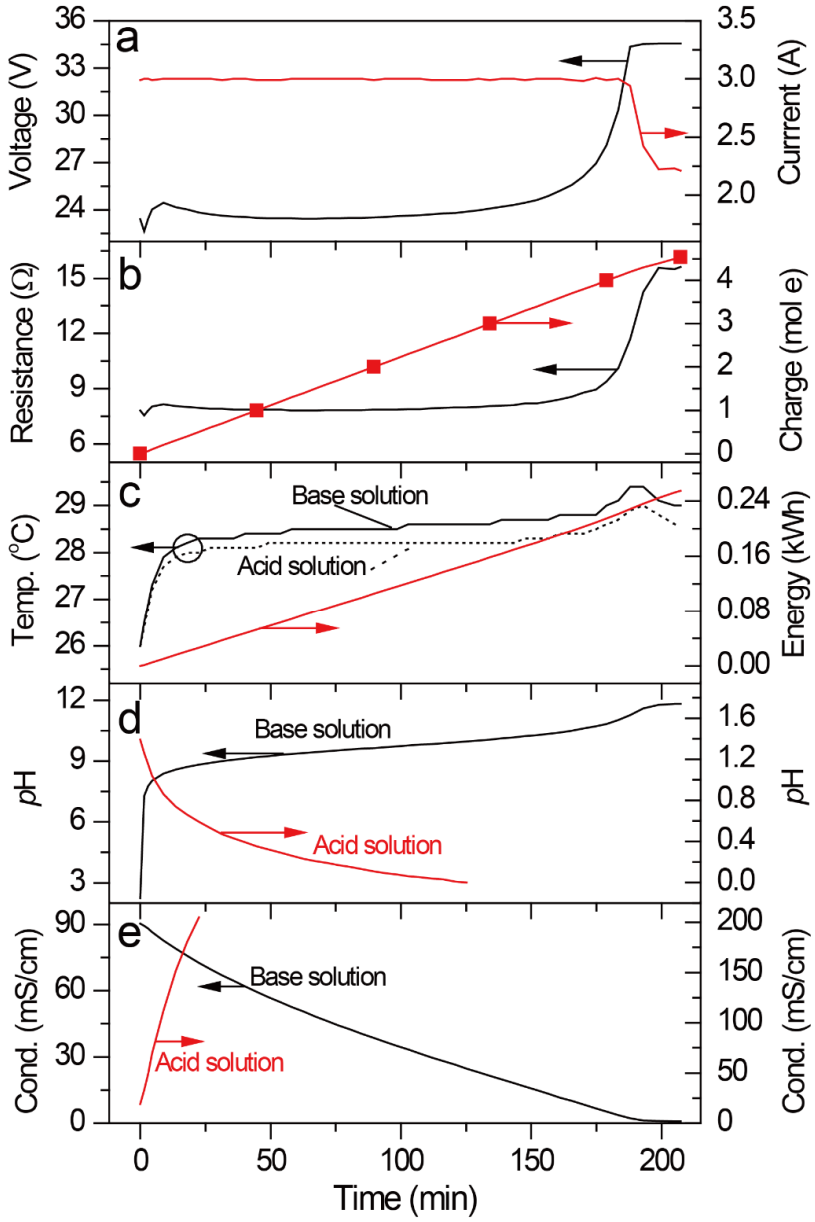

Fig. S8 Online data profiles of the EDBM process with L-Alaninol chloride solution. (a) Stack voltage and current curves. (b) Stack resistance and charge transferred. (c) The temperature and the EDBM energy consumption curves. (d) The pH variations of both acid and base solutions. (e) The conductivity curves of both acid and base solutions. The conductivity of acid solution exceeds the upper limit (200 mS/cm) of the instrument after 23 min.

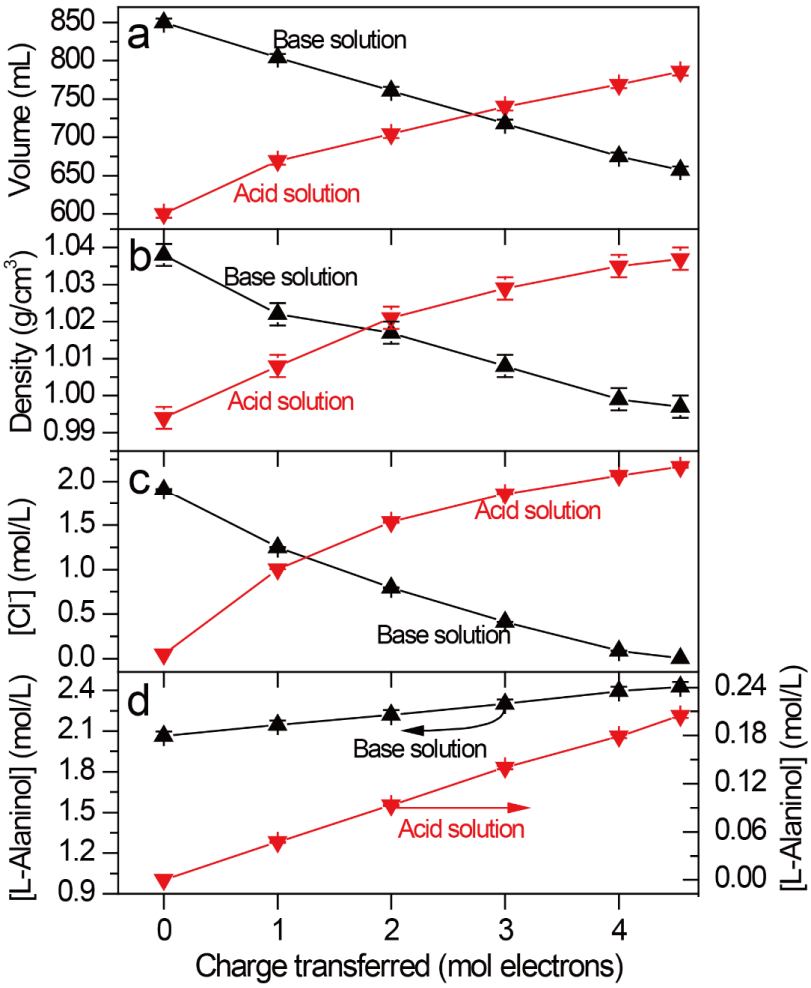

Fig. S9 Offline sample analysis results during the EDBM process with L-Alaninol chloride solution. (a) Volume variations of acid and base solutions. (b) Density variations of acid and base solutions. (c) Concentration of total P variations of acid and base solutions. (d) Concentration of L-Alaninol variations of acid and base solutions.

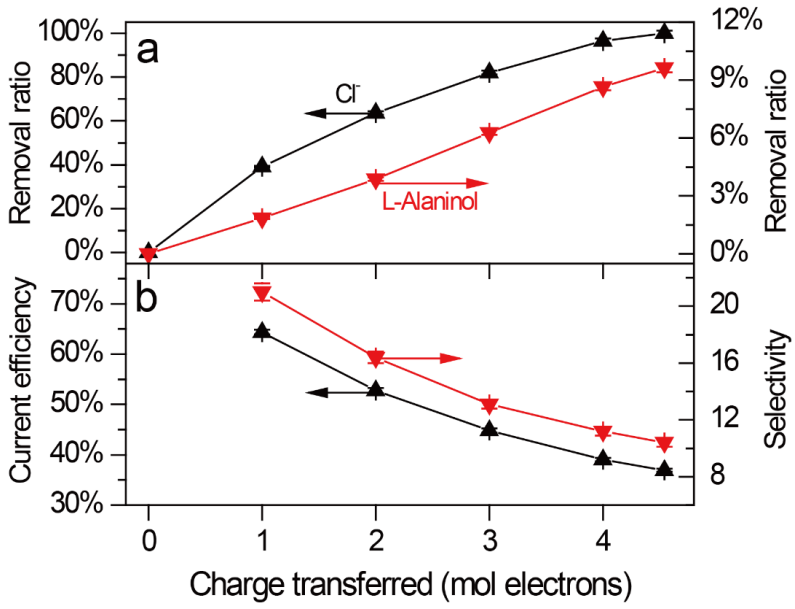

Fig. S10 (a) The removal ratio of chloride and L-Alaninol. (b) The corresponding permselectivity of chloride over L-Alaninol, as well as the cumulative current efficiencies.

Table S2. Cost estimation of the EDBM process with L-Alaninol chloride.

Items			Notes
Capital cost			
Area of AEM	0.072	m^2	
Area of BP	0.072	m^2	
Price of AEMs	360	$/$m^2$	
BP-Price	720	$/$m^2$	
Membrane cost	77.76	$	
Stack cost	116.64	$	*1.5 times of membrane*
Peripheral equipment cost	58.32	$	*0.5 times of stack*
Total capital cost	174.96	$	
Operational cost			
Energy	0.255	kWh	
Batch time	207	min	
Product concentration	2.427	mol/L	
Product volume	657	mL	
Batch productivity	1.595	mol	
Overall cost			
System lifespan	16000	h	*2-year estimation*
Total productivity	554.6	kg	*As pure L-Alaninol*
Capital cost	0.315	$/kg	
Energy	2.13	kWh/kg	
	0.213	$/kg	*$0.10/kWh power price*
Total cost	0.528	$/kg	*Capital + energy*