**Fig. 1.** The ionic rectification effect of the heterogenous ZIF-8/PSS$_X$@ANMs. (a) The scanned I-V curves as a function of PSS content measured in 1 mM LiCl methanol solution; (b) Asymmetric structure of ZIF-8/PSS@ANM leads to the ionic-diode behavior.



**Fig. 2.** High-performance osmotic energy harvesting from a salinity gradient in organic solution. (a) The measured current and power densities of ZIF-8/PSS$_2$@ANM harvested in organic (red curve) and aqueous (blue curve) solutions; (b) Schematic of the size-exclusion effect of the subnanochannel ZIF-8/PSS@ANM of hydrated Li$^+$ ions in aqueous solution and dehydrated Li$^+$ ions in methanol solutions promoting the boosted Li$^+$ transport in organic solution.