Fig.S1 The relationship between temperature and conductivity of the oxidized Nb$_{1.33}$Ti$_{0.67}$O$_4$ (Nb$_2$TiO$_7$) sample.
**Fig. S2** The relationship between temperature and conductivity of oxide NbTi$_{0.5}$Ni$_{0.5}$O$_4$ sample.
Fig.S3 The relationship between temperature and conductivity of the NbTi$_{0.5}$Cu$_{0.5}$O$_4$ sample which was exposed to 5%H$_2$/Ar when the temperature reaches 730$^\circ$C.
Fig. S4 AC impedance of the symmetric solid oxide cells NTO-SDC/YSZ/NTO-SDC tested at 800 °C in pure H₂ under different current densities, where the NTO is Nb₁.₃₃Ti₀.₆₇O₄.
**Fig.S5** AC impedance of the symmetric solid oxide cells NTO-SDC/YSZ/NTO-SDC tested at 800 °C at OCV under different hydrogen partial pressure, where the NTO is Nb$_{1.33}$Ti$_{0.67}$O$_4$. 
Fig.S6  I-V curve of the solid oxide electrolyzer based on Ni-SDC fuel electrode for steam electrolysis (4%H₂/Ar/3%H₂O) at 800 ºC.
**Fig. S7** AC impedance of the solid oxide electrolyzer based on Ni-SDC composite fuel electrodes for steam electrolysis with 4%H₂/Ar/3%H₂O fed to fuel electrode and oxygen electrode in static air at 800 °C.
Fig. S8 (a) Short-term performance of the solid oxide electrolyzers based on Ni-SDC fuel electrodes for steam electrolysis (4%H₂/Ar/3%H₂O); (b) H₂ production and current efficiency based on Ni-SDC composite fuel electrodes.