

Solar-Microbial Hybrid Device based on Oxygen-deficient Niobium Pentoxide Anodes for Sustainable Hydrogen Production

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Video S1. This video shows the real time hydrogen production in PEC-MFC hybrid device with/without the illumination. The PEC and MFC was combined in series. The release of gases from the Nb₂O_{5-x} NPs and bubbling can be observed starting after introducing the white light at 00:15.

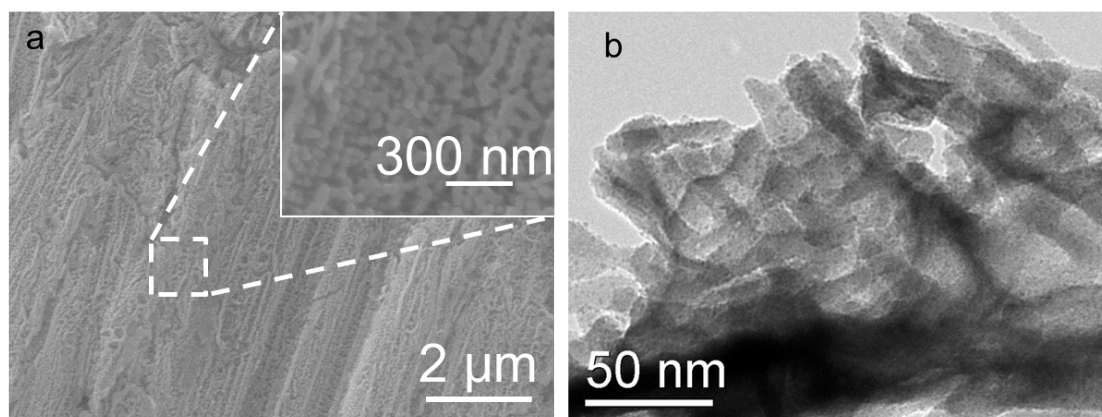


Figure S1. (a) SEM and (b) TEM images of Nb_2O_5 NPs.

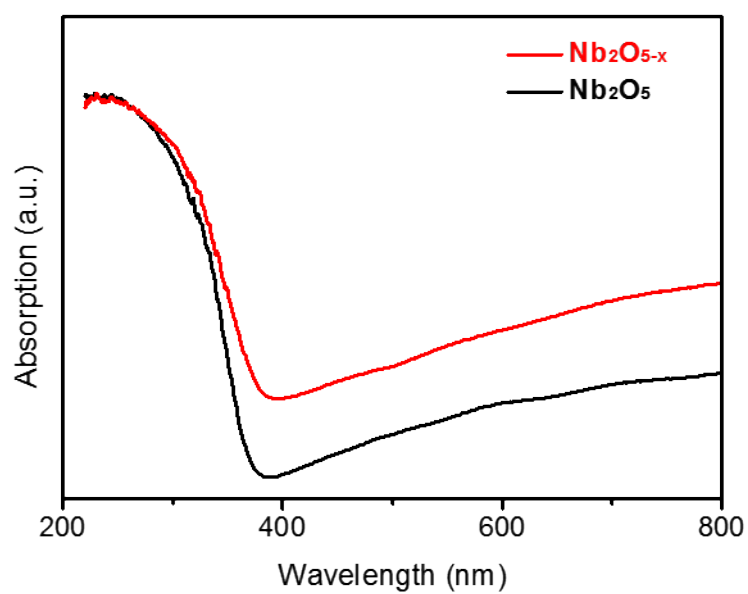


Figure S2. Absorption UV-visible spectra of Nb_2O_5 and $\text{Nb}_2\text{O}_{5-x}$ NPs; inset: picture of Nb_2O_5 and $\text{Nb}_2\text{O}_{5-x}$ NPs.

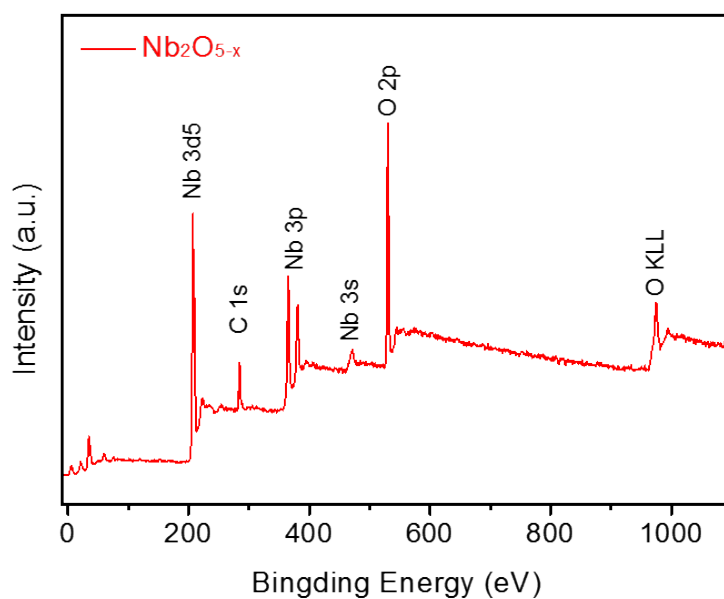


Figure S3. XPS survey spectrum collected for $\text{Nb}_2\text{O}_{5-x}$ NPs.

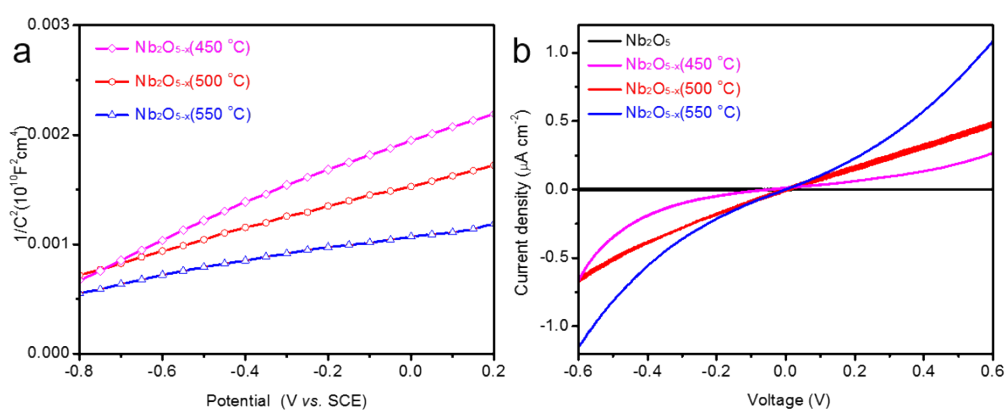


Figure S4. (a) Mott-Schottky plots of $\text{Nb}_2\text{O}_{5-x}$ NPs treated at different temperature at a frequency of 1 kHz in the dark; (b) Comparison of I - V curves of the samples.

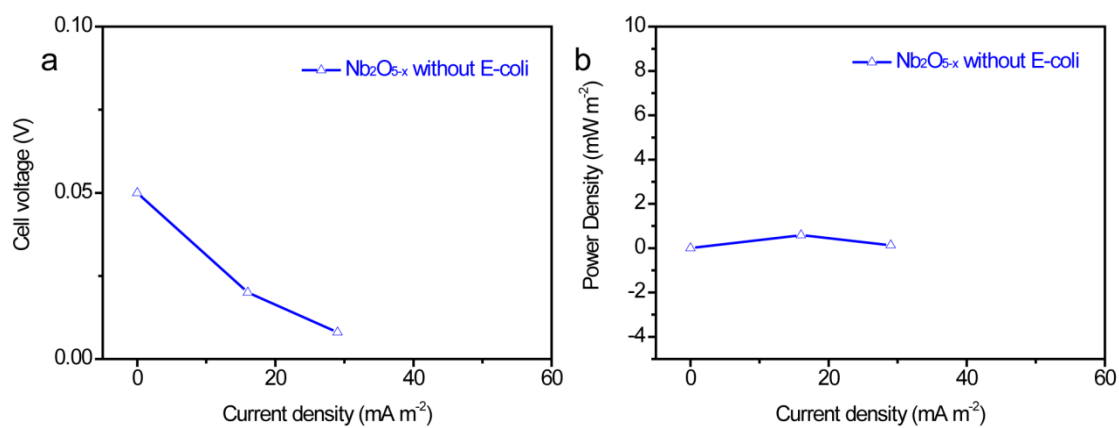


Figure S5. (a) polarization curves and (b) power outputs for $\text{Nb}_2\text{O}_{5-x}$ -MFC without E-coli.

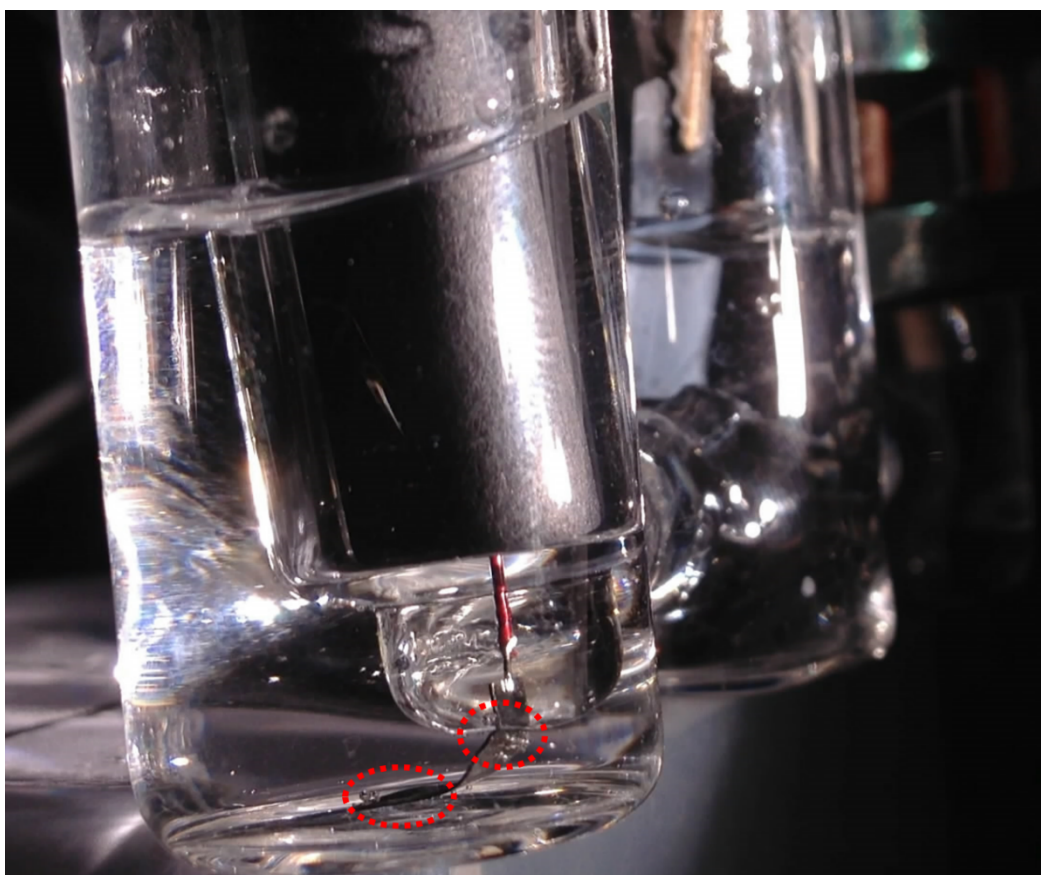


Figure S6. The red circle showing gas bubbles evolving from the Pt electrode under the illumination in the PEC-MFC hybrid device.

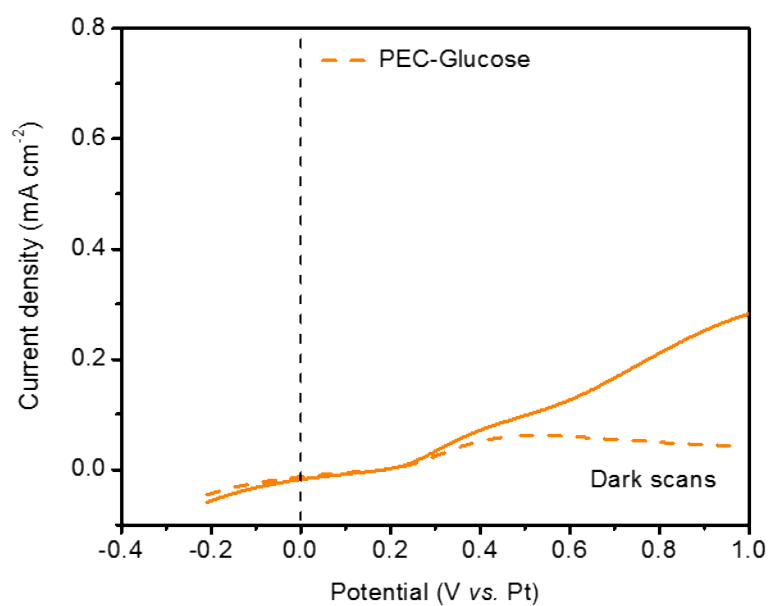


Figure S7. *I-V* curves collected from a PEC device in the presence of glucose agent (orange) with the Nb₂O_{5-x} NPs electrodes at a scan rate of 10 mV/s with/without the white light illumination.

Table S1. The summary of the photocurrent of Nb₂O₅-based electrodes.

Electrode	Electrolyte	Potential window ^a (vs. Ag/AgCl); ^b (vs. SCE)	Photocurrent	Illumination intensity	Ref.
N-doped Nb ₂ O ₅	0.1 M Na ₂ SO ₄	0 – 0.8 V ^a	0.014 mA/cm ² at 0.8 V	N. A.	[1]
Ag ₂ Nb ₄ O ₁₁	0.5 M Na ₂ SO ₄	0.4 – 1.0 V ^a	0.003 mA at 1.0 V	N. A.	[2]

Bi_3NbO_7	0.5 M Na_2SO_4	0 – 1.0 V ^b	0.01 mA/cm ² at 1.0 V	150 mW/cm ²	[3]
$\text{Fe}_2\text{O}_3/\text{Nb}_2\text{O}_5$	A buffer solution of pH=7 containing 0.2 M $\text{Na}_2\text{B}_4\text{O}_7$, 0.14 M H_2SO_4 , and 0.3 M Na_2SO_4	0 – 1.5 V ^b	0.8 mA/cm ² at 0.75 V	N. A.	[4]
$\text{Nb}_2\text{O}_{5-x}$	1.0 M NaOH	-1.0 – 0.6 V ^b	0.9 mA/cm ² at 0.6 V	100 mW/cm ²	This work

SI References:

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