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Supplementary Information

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3 **Preparation of expandable vertically aligned carbon nanotube** 4 **arrays/polydimethylsiloxane membrane by modular splicing method** 5 **and its application in *in situ* ethanol recovery from ethanol** 6 **fermentation**

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1 Pervaporation experiment

2 The effective area of membrane in membrane module was 58 cm². All the
3 pervaporation experiments were conducted at the feed flow rate of 1.2 L/min and a
4 vacuum of < 100 Pa on the permeate side of the membrane. The permeate was collected
5 in a cold trap immersed in liquid nitrogen.

6 The flux (J , g/m² h), separation factor (α) and Pervaporation Separation Index
7 (PSI) were calculated as follows:

$$8 \quad J = \frac{w}{At} \quad (1)$$

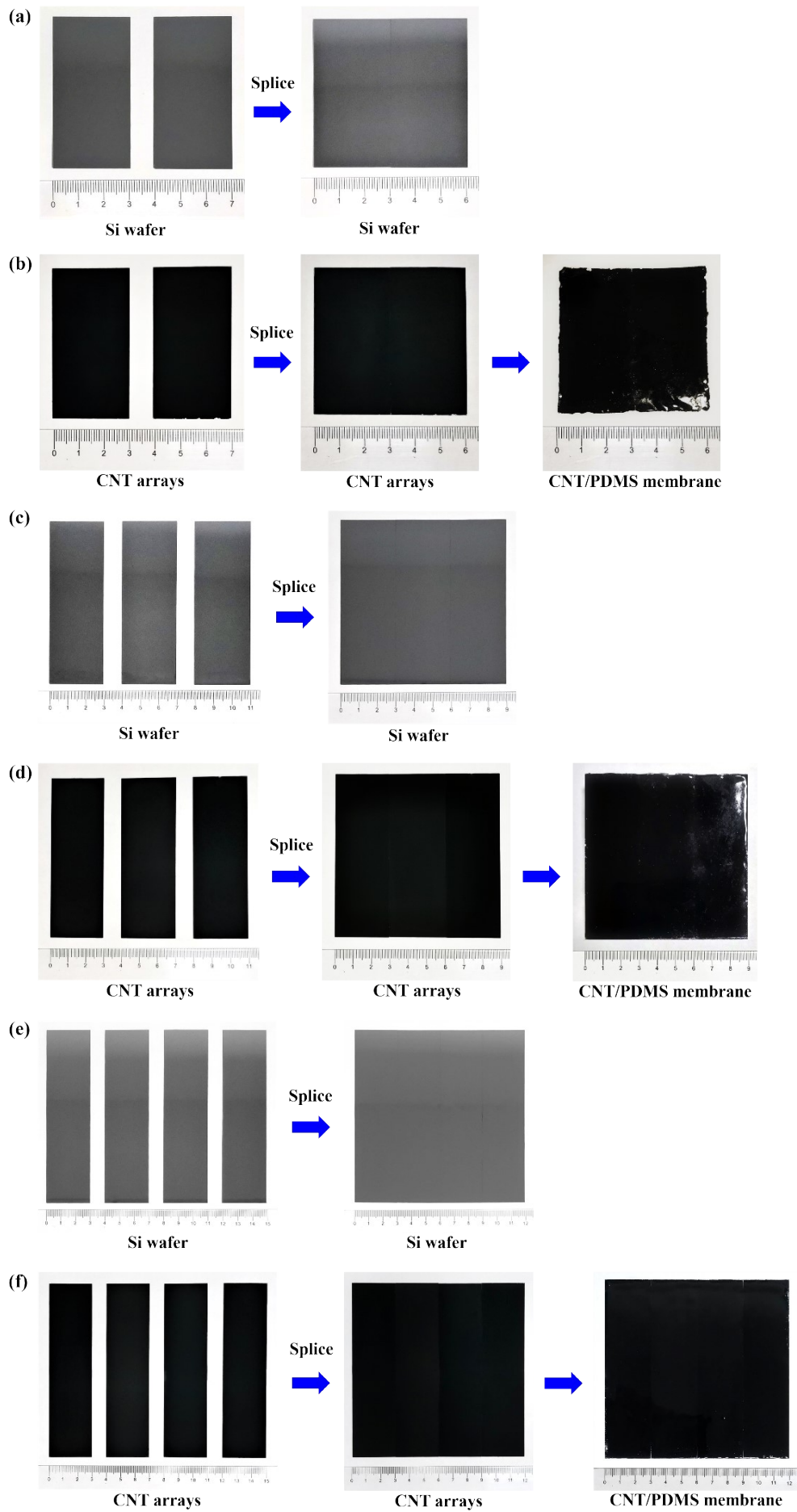
$$9 \quad x_i \text{ or } y_i = \frac{C_i}{(1000 - C_i/\rho_i + C_i)}$$

10 (2)

$$11 \quad \alpha_i = \frac{y_i/(1 - y_i)}{x_i/(1 - x_i)} \quad (3)$$

$$12 \quad PSI = J\alpha_i \quad (4)$$

13 where W (g) is the weight of the recovered permeate, A (m²) is the membrane area, and
14 t is the time (h) for the sample collection. x_i and y_i are the weight fractions of
15 components in the feed and permeate samples, respectively. C_i is the titer (g/L) of
16 components in the feed and permeate samples. ρ_i is the relative density (g/cm³) of
17 components in the feed and permeate samples. The definition and function of PSI can
18 be used to characterize as the separation effectiveness of pervaporation possessing with
19 different separation factor and flux.



1 **Figure. S1** Photos of Si wafers, CNT arrays and CNT arrays/PDMS membranes with
2 different sizes: a) individual Si wafers ($3\text{ cm} \times 6\text{ cm}$) and their spliced Si wafers; b)
3 individual CNT arrays ($3\text{ cm} \times 6\text{ cm}$), the spliced CNT arrays, and the prepared CNT
4 arrays/PDMS membrane ($6\text{ cm} \times 6\text{ cm}$); c) individual Si wafers ($3\text{ cm} \times 9\text{ cm}$) and their
5 spliced Si wafers; d) individual CNT arrays ($3\text{ cm} \times 9\text{ cm}$), the spliced CNT arrays,
6 and the prepared CNT arrays/PDMS membrane ($9\text{ cm} \times 9\text{ cm}$); e) individual Si wafers
7 ($3\text{ cm} \times 12\text{ cm}$) and their spliced Si wafers; f) individual CNT arrays ($3\text{ cm} \times 12\text{ cm}$),
8 the spliced CNT arrays, and the prepared CNT arrays/PDMS membrane ($12\text{ cm} \times 12$
9 cm).