Electronic Supplementary Information

Hollow and mesoporous ZnTe microspheres: synthesis and visible-light photocatalytic reduction of carbon dioxide into methane

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RSC Advances

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Calculation Details of Solar Energy Conversion Efficiency

Gas Chromatographic Analysis

Stability Analysis

Calculation Details of Solar Energy Conversion Efficiency (%)

The amount of energy converted relative to the irradiated solar power in terms of conversion efficiency (%) can be calculated with the following formula:

$$conversion\ efficiency\ (\%) = \frac{amount\ of\ energy\ converted\ (W)}{irradiated\ solar\ power\ (W)} \times 100$$

(1)

The amount of energy converted was determined by the following formula:

$$amount\ of\ energy\ converted = mass\ of\ CH_4\ produced\ (Kg) \times energy\ density\ of\ CH_4(\frac{W}{Kg})$$

(2)

$$mass\ of\ CH_4\ produced = n[CH_4(moles)] \times [M\ (g.mole^{-1})]$$

(3)

Where, n(CH_4) is the total amount of methane produced after 0.5 hours and M is the molecular weight of CH_4.

Putting the values obtained from the experimental results in eq. (3)

$$mass\ of\ CH_4\ produced = 1.89 \times 10^{-6}\ (moles) \times 16.04\ (g.mole^{-1})$$

$$mass\ of\ CH_4\ produced = 3.03 \times 10^{-5}\ g = 3.03 \times 10^{-8}\ Kg$$

(4)

We already know that

$$energy\ density\ of\ CH_4 = 55.6\ (\frac{MJ}{Kg})$$

(5)

By putting Eq. (4) and Eq. (5) in Eq. (2)

$$amount\ of\ energy\ converted = 3.03 \times 10^{-8}\ (Kg) \times 55.6(\frac{MJ}{Kg})$$

$$amount\ of\ energy\ converted = 1.68 \times 10^{-6}\ (MJ) = 1.68\ (J)$$

$$amount\ of\ energy\ converted\ (W) = \frac{1.68\ (J)}{1800\ (s)} = 9.33 \times 10^{-4}\ (W)$$

(6)

The power of the solar irradiation $\lambda \geq 420\ nm$ was determined from ILT 950 Spectrodiometer (International Light Technologies) and is given as under:

$$irradiated\ solar\ power\ (W) = 1.3\ W$$

(7)

Putting the values from Eq. (6) and Eq. (7) in Eq. (1)

$$conversion\ efficiency\ (\%) = \frac{9.33 \times 10^{-4}\ (W)}{1.3\ (W)} \times 100\%$$

$$conversion\ efficiency\ (\%) = 0.072\ \%\ (for\ hollow\ and\ mesoporous\ ZnTe\ microspheres)$$

Similarly, the conversion efficiency was also calculated for ZnTe nanocrystals and the value has been given as following:

$$conversion\ efficiency\ (\%) = 0.034\ \%\ (for\ ZnTe\ nanocrystals)$$

Gas Chromatographic Analysis

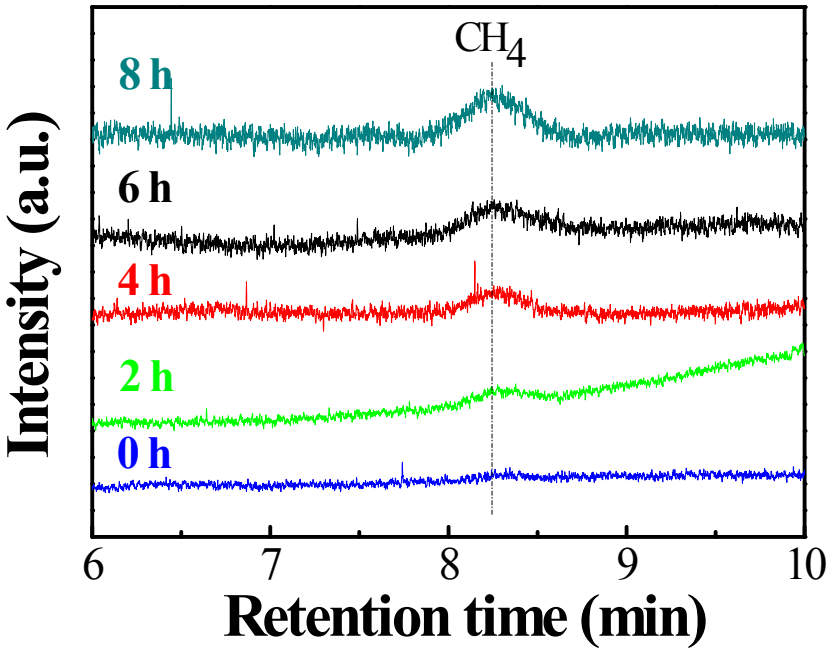

Fig. S1 GC plots for the photoreduction of CO_2 into CH_4 over ZnTe hollow and mesoporous microspheres after different time intervals.

Stability Analysis

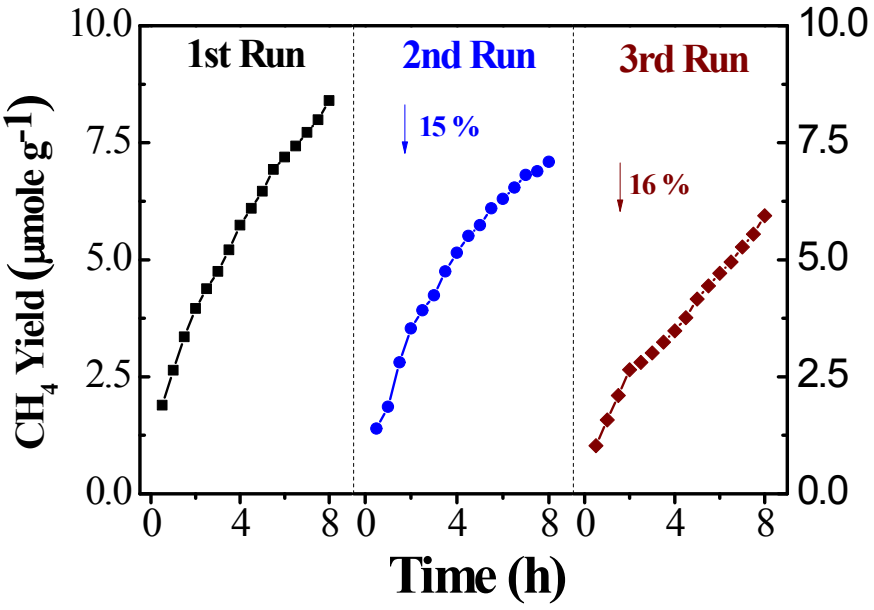

Fig. S2 Various runs of CO_2 photoreduction for production of CH_4 over hollow and mesoporous ZnTe microspheres.