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Supplementary Information

Efficient Visible Light Photocatalysis and Tunable Photoluminescence from Orientation Controlled Mesoporous Si Nanowires

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Section I: Details of MACE Process

Wafer details:

- Sample S1: Si(100), p-type, 0.01 Ω-cm
- Sample S2: Si(111), p-type, 0.001 Ω-cm

Wafer size: 2□1 cm^2

Wafer cleaning: The Si wafers were initially cleaned by rinsing in acetone followed by ethanol for 5 min in each step. The wafers were further cleaned in piranha solution (a 5:1 mixture of sulfuric acid (H_2SO_4) and hydrogen peroxide (H_2O_2)) for 10 min to remove the metallic and alkaline contamination as well as for the reduction of organic residues on the surface. Native oxide layer (SiO_2) was removed by immersing the wafers in 10% hydrofluoric acid (HF) for a few mins. The samples were rinsed in de-ionized (DI) water after each step. Finally the cleaned wafers were dried by an argon (Ar) blow.

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Etching steps: For the MACE of the cleaned Si wafers, we used a two-step process. The first step is metal deposition on Si wafers and the second step is the HF:H_2O_2 based etching.

Metal deposition: A thin layer of Ag nanoparticles (NPs) was deposited on the Si wafers by dipping the cleaned Si wafers in a solution containing 5.55 M HF and 0.015 M $AgNO_3$. In a teflon beaker, 5 mL HF (50%) was mixed with 25 mL DI water. Then, 63.7 mg $AgNO_3$ was added to the solution and stirred for 10 mins. The cleaned Si wafer was then dipped into the solution for 5 seconds. The Ag NPs deposition was performed in room temperature (RT, ~25℃).

Etching: The as-deposited Si substrates were immersed in a solution containing HF and H_2O_2 for 20 min at RT. Various samples in different groups (S1 and S2) are grown by changing the HF amount from 2 mL to 8 mL, keeping H_2O_2 (2 ml) and DI water (23 mL) volume fixed. In order to remove the residual Ag NPs on the surface and pores of the Si NWs, the samples were dipped into the 10% aqueous solution of HNO_3 (volume ~25 mL) for 3 mins. The samples were cleaned in DI water after each step. The as-grown Si NWs sample were dried in Ar gas and stored in desiccator before further measurements.

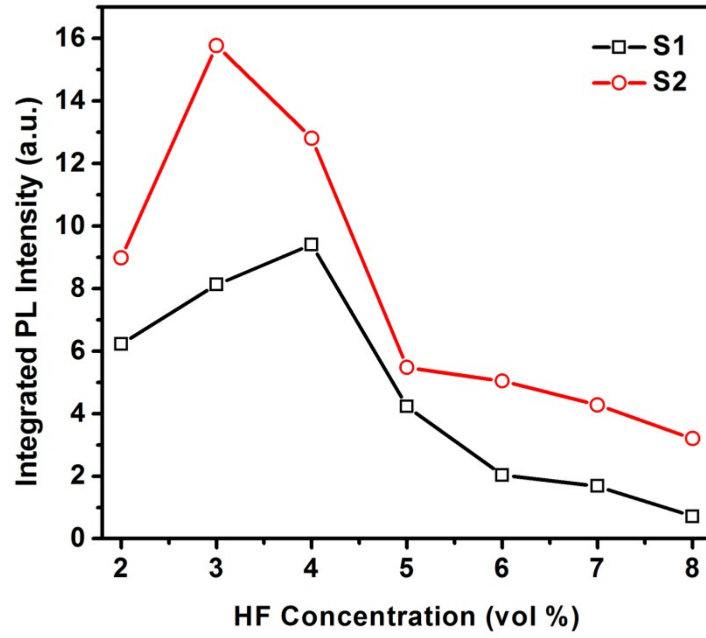

Fig. SI1. The comparison of the integrated PL intensity as a function of HF concentration in groups S1 and S2.

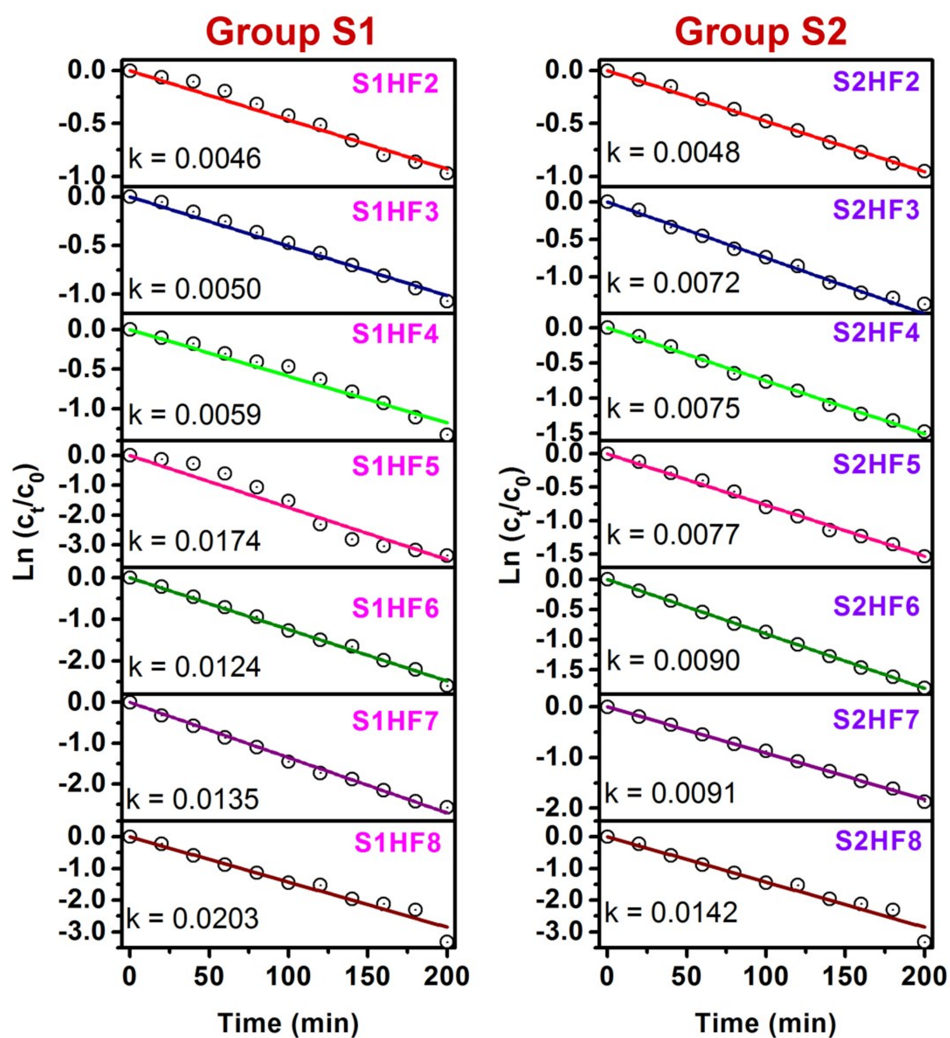

Fig. SI2. *ln* (C_t/C_0) as a function of time for different samples in group S1 (column 1) and group S2 (column 2). The data points are shown with symbols, while the linear fit is shown by a solid line in each case. The k-value in each case is denoted in min^{-1} unit.