Electronic Supporting Information (ESI) for

An Ion Exchange Approach Assembled Multi-Dimensional Hierarchical Fe-TiO_2 Composite Micro-/Nano Multi-Shell Hollow Spheres for Bacteria Lysis Through Utilizing Visible Light

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Experimental Procedure

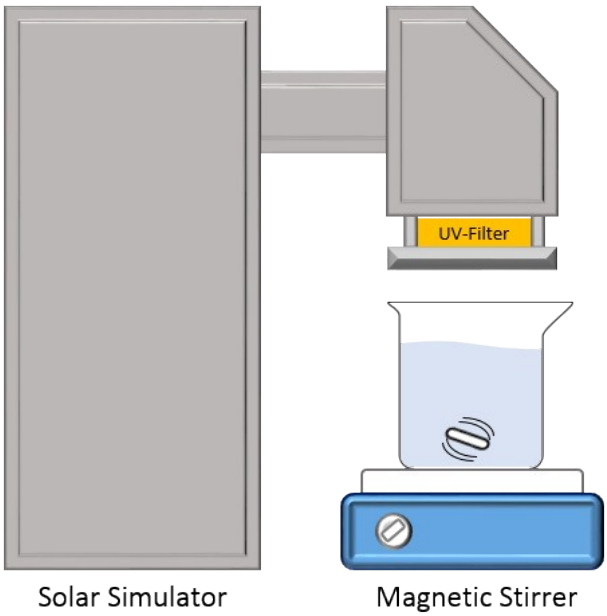

Figure 1 Visible light degradation of E. Coli using Solar Simulator

FESEM & EDX Analysis

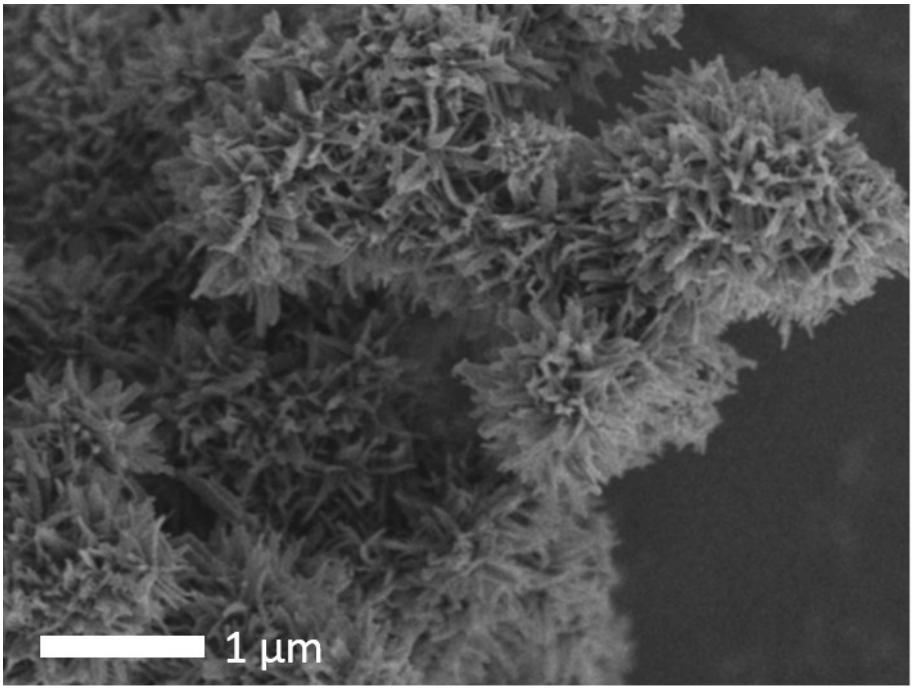

Figure 2 Overview of HMS-6

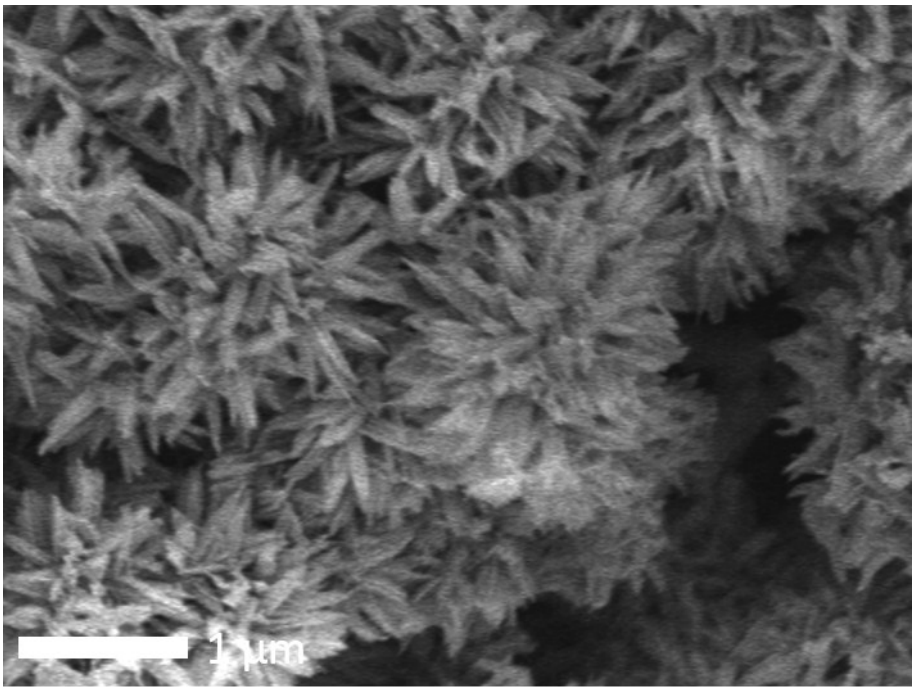

Figure 3 Overview of HMS-24

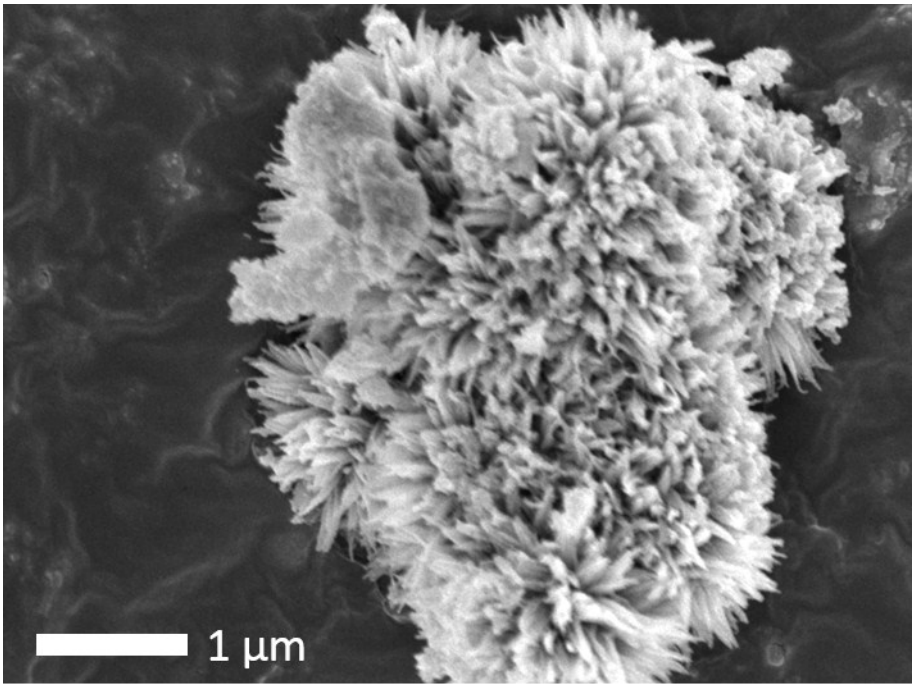

Figure 4 Overview of HMS-24

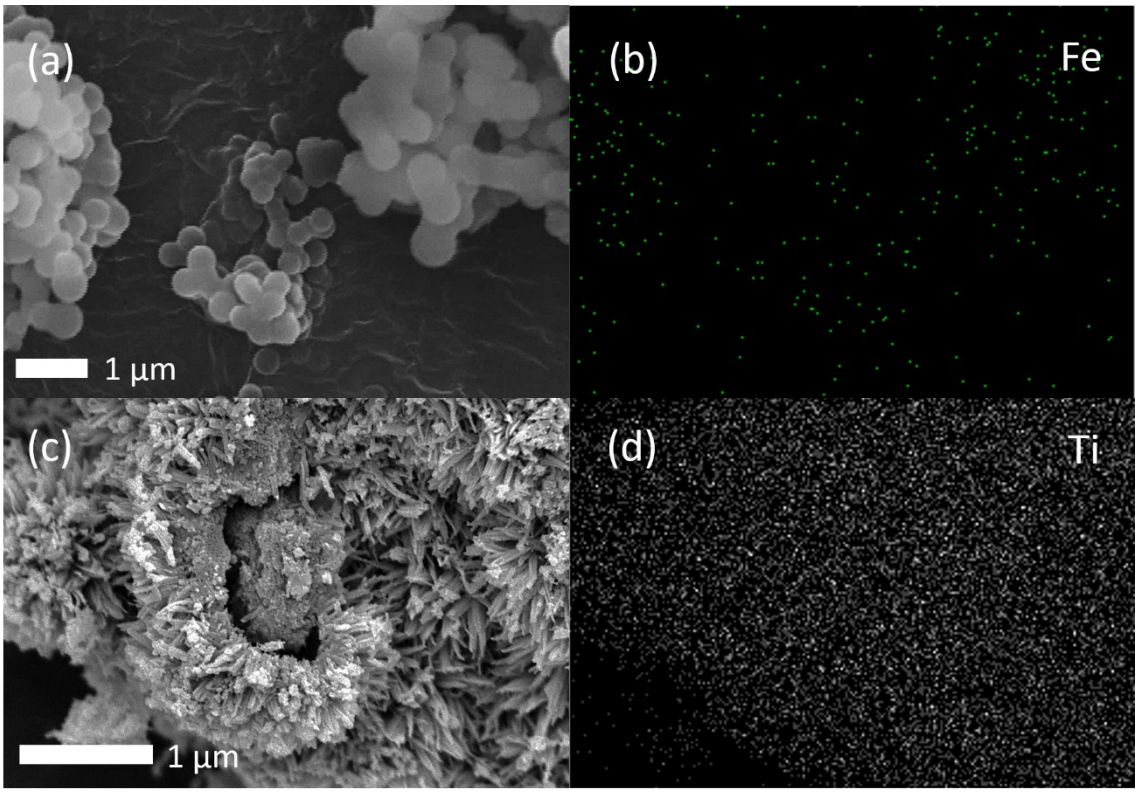

Figure 5 (a) Fe-C spheres and the corresponding (b) EDX analysis of low Fe content. (c) The FESEM imaging of HMS-1 with the hierarchical thorn like structure and nanoparticulate inner

sphere. (d) The corresponding EDX analysis revealing the formation of Ti dominated inner shell revealing the inter-diffusion of Ti-glyercolate and Fe, while Fe element remains undetectable.

XRD Pattern and Indexing of HMS

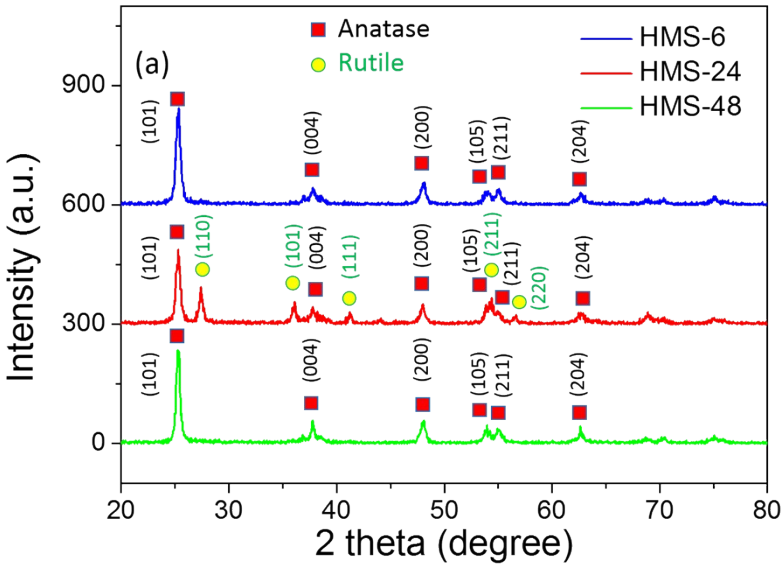

Figure 6 XRD pattern of HMS-6, HMS-24 and HMS-48 revealing Anatase TiO_2 phases and the Rutile phase in HMS-24.

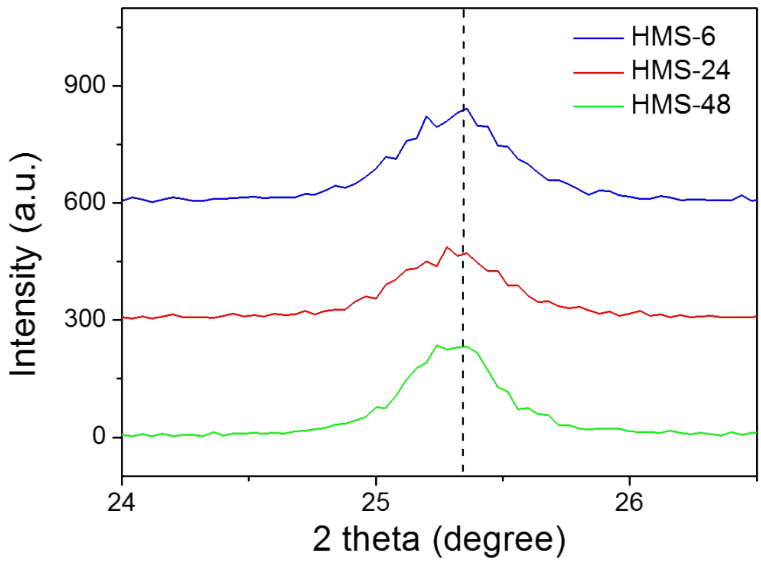

Figure 7 Shift in the 101 anatase TiO_2 phases of HMS-6, HMS-24 and HMS-48 with increased Fe content.

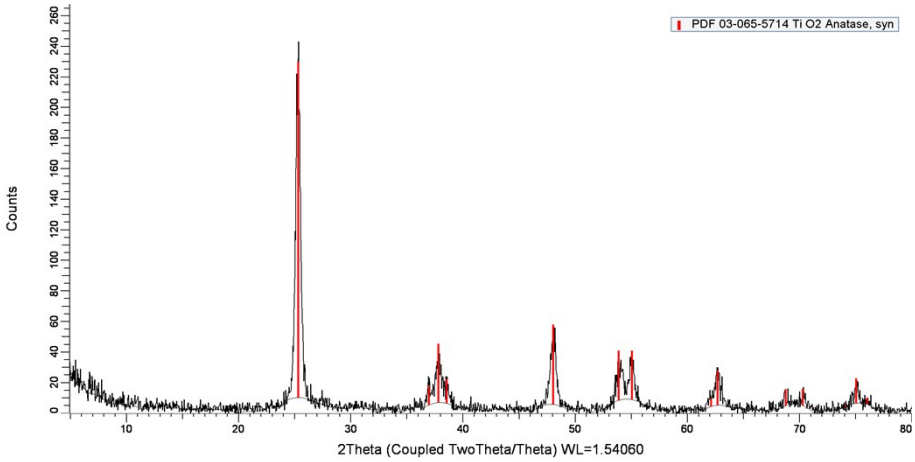

Figure 8 XRD of HMS-6 index to Anatase Phase of TiO_2

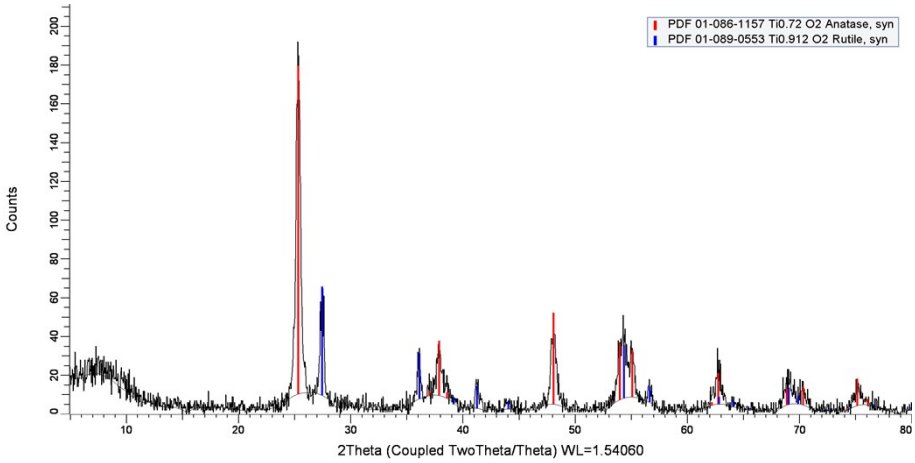

Figure 9 XRD of HMS-24 index to Anatase and Rutile Phase of TiO_2

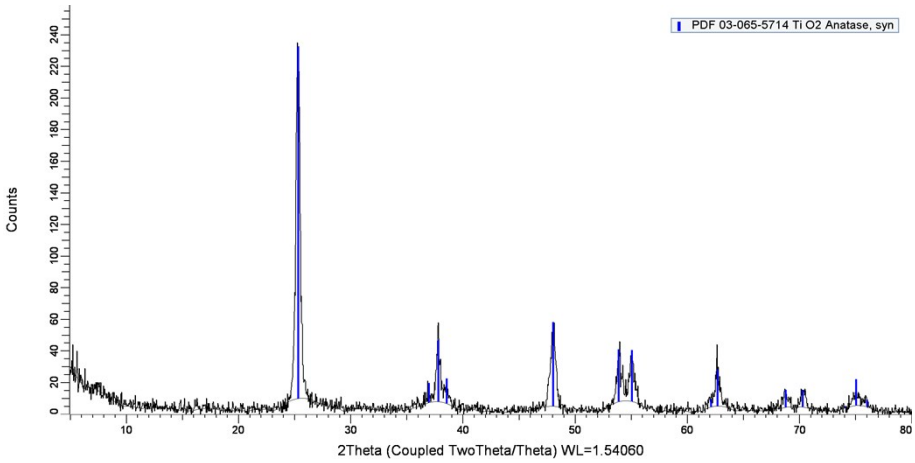

Figure 10 XRD of HMS-48 index to Anatase Phase of TiO_2

Thermogravimetric Analysis (TGA) of HMS

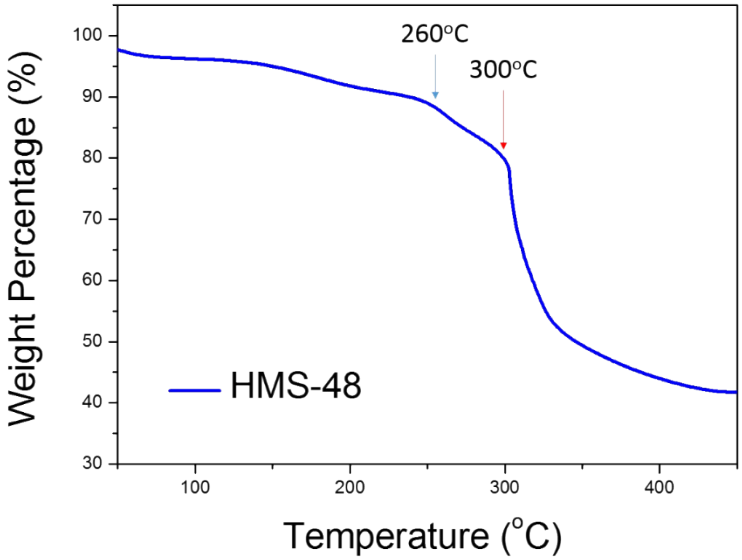

Figure 11 TGA of HMS-48 and the weight reduction at 290°C which reveal the oxidation of glycerolate and the carbonaceous spheres.

Scherrer Equation Tabulation of the HMS

Table 1 Estimated grain size of the 101 Anatase Phase respective HMS using the Scherrer Equation

Denote	Unit	HMS-6 TiO_2 A (101)	HMS-24 TiO_2 A (101)	HMS-24 TiO_2 A (110)	HMS-48 TiO_2 A (101)
2θ	°	25.32	25.32	27.46	25.32
θ	°	12.66	12.66	13.73	12.66
Cos(θ)	-	0.976	0.976	0.971	0.976
FWHM	°	0.46	0.436	0.378	0.4
FWHM (β)	radian	0.0080	0.0076	0.0066	0.0070
βCos(θ)	-	0.0078	0.0074	0.0064	0.0068
λ	nm	0.15418	0.15418	0.15418	0.15418
k	-	0.89	0.89	0.89	0.89
d_c	nm	17.54	18.50	21.44	20.17