Nanostructured ZnS:Ni$^{2+}$ Photocatalysts Prepared by Ultrasonic Spray Pyrolysis

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Figure S1. Ultrasonic spray pyrolysis (USP) experimental apparatus.

Figure S2. (a and b) SEM micrographs, (c) dark-field TEM image, and (d) SAED pattern of nanostructured ZnS:Ni$^{2+}$ hollow microspheres.

Figure S3. SEM and TEM micrographs of nanostructured ZnS:Ni$^{2+}$ hollow microspheres before (a and b, respectively) and after (c and d, respectively) HF treatment.

Figure S4. (a) STEM dark-field image and (b and c) STEM-EDS line analysis of nanostructured ZnS:Ni$^{2+}$ hollow microspheres.

Figure S5. STEM-EDS elemental mapping analysis of nanostructured ZnS:Ni$^{2+}$ hollow microspheres.
Figure S6. SEM and TEM micrographs of ZnS:Ni$^{2+}$ nanoparticles before (a and b, respectively) and after (c and d, respectively) HF treatment.

Figure S7. STEM-EDS elemental mapping analysis of ZnS:Ni$^{2+}$ nanoparticles.

Figure S8. TEM-EDS analysis of ZnS:Ni$^{2+}$ nanoparticles (a) before and (b) after HF treatment.

Figure S9. (a) Nitrogen adsorption and desorption isotherms of nanostructured ZnS:Ni$^{2+}$ hollow micro-spheres and (b) their pore size distribution obtained from adsorption branch using BJH method.

Figure S10. High resolution TEM micrographs of (a and b) nanostructured ZnS:Ni$^{2+}$ hollow microspheres and (c) ZnS:Ni$^{2+}$ nanoparticles.
Figure S11. (a) Diffuse reflectance UV-vis spectra, (b) XRD patterns, and (c) BET surface areas of ZnS:Ni\textsuperscript{2+} powders obtained by a co-precipitation method (a) before and (b) after heat-treatment (500 °C, 2 h under Ar flow). Note that trace of ZnO phase formation (marked as asterisks) was observed in the heat-treated sample even with long pre-purging (2 hrs) of Ar gas prior to heat-treatment.

<table>
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<tr>
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<th>ZnS:Ni\textsuperscript{2+} powder before heat-treatment</th>
<th>ZnS:Ni\textsuperscript{2+} powder after heat-treatment</th>
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<tr>
<td>BET surface area (m\textsuperscript{2}/g)</td>
<td>113</td>
<td>1.7</td>
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Figure S12. SEM micrographs of ZnS:Ni\textsuperscript{2+} powders obtained by a co-precipitation method (a) before and (b) after heat-treatment.

Figure S13. Transmission spectrum of a water filter containing 2 M NaNO\textsubscript{2}. 