Synergistic doping effects of ZnO:N/BiVO₄:Mo bunched nanorod array photoanode for enhancing charge transfer and carrier density in photoelectrochemical systems

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Fig. S1. TEM, HRTEM and EELS elemental mapping images of a) ZnO, b) ZnO:N, c) BiVO$_4$ and d) BiVO$_4$:Mo, e) FFT pattern of ZnO:N and BiVO$_4$:Mo.
Fig. S2. Secondary ion mass spectroscopy (SIMS) depth profiling of a) ZnO, b) ZnO:N, c) BiVO₄, and d) BiVO₄:Mo.
Fig. S3. Linear-sweep voltammetry curves of a) ZnO and ZnO:N NRs prepared with various reductive annealing times, b) ZnO/BiVO$_4$ and ZnO:N/BiVO$_4$ prepared with various reductive annealing times, c) ZnO/BiVO$_4$ and ZnO/BiVO$_4$:Mo prepared with various Mo precursor ratio to V precursor.
Fig. S4. UV-vis absorption spectra of ZnO, ZnO:N, BiVO₄ and BiVO₄:Mo samples.
Table S1. Parameters of PL decay kinetics for ZnO, ZnO:N, ZnO/BiVO₄, ZnO:N/BiVO₄, ZnO/BiVO₄:Mo, and ZnO:N/BiVO₄:Mo samples through fitting with three-exponential decay.

<table>
<thead>
<tr>
<th>Material</th>
<th>A₁</th>
<th>τ₁ (ns)</th>
<th>A₂</th>
<th>τ₂</th>
<th>A₃</th>
<th>τ₃</th>
<th>&lt;τ&gt;</th>
<th>kₑₙ (s⁻¹)</th>
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<tr>
<td>ZnO</td>
<td>0.00912</td>
<td>805.46</td>
<td>0.06779</td>
<td>60.94</td>
<td>3.85199</td>
<td>4.38</td>
<td>220.201</td>
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<td>ZnO:N</td>
<td>0.02917</td>
<td>339.53</td>
<td>0.19994</td>
<td>26.4</td>
<td>9.16527</td>
<td>2.48</td>
<td>93.86</td>
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<td>ZnO/BiVO₄</td>
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<td>3.66809</td>
<td>0.21429</td>
<td>0.26315</td>
<td>1.15284</td>
<td>0.01302</td>
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<td>ZnO:N/BiVO₄</td>
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<td>3.14099</td>
<td>0.21528</td>
<td>0.18465</td>
<td>1.7075</td>
<td>0.00808</td>
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<td>ZnO:BiVO₄:Mo</td>
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<td>2.79783</td>
<td>0.20054</td>
<td>0.16553</td>
<td>1.64765</td>
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<td>ZnO:N/BiVO₄:Mo</td>
<td>0.03654</td>
<td>2.80023</td>
<td>0.18839</td>
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Table S2. Fitting parameters for EIS data of ZnO, ZnO:N, ZnO/BiVO₄, ZnO:N/BiVO₄, ZnO/BiVO₄:Mo, and ZnO:N/BiVO₄:Mo samples.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Rₛ (Ω)</th>
<th>Rₓ (Ω)</th>
<th>Cₛ (10⁻¹² F)</th>
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<tr>
<td>ZnO/BiVO₄</td>
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<td>69.47</td>
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<td>ZnO:N/BiVO₄</td>
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<td>3584</td>
<td>74.1</td>
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<td>ZnO:N/BiVO₄:Mo</td>
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<td>85.13</td>
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