Supplementary Information:

Cerium oxide based active catalyst for Hydroxylammonium Nitrate (HAN) fueled monopropellant thrusters

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**Constant Volume batch reactor:** It essentially consists of a small enclosed chamber wherein the pressure and temperature rise arising from the decomposition of the monopropellant when injected onto a catalyst bed can be monitored as a function of time.

![Batch reactor schematic](image)

*Fig. S1 Schematic of the Batch reactor.*

**Batch reactor studies on CeCo 26-HAN:** The pressure–time curves obtained for CeCo 26 shows that the cerium based catalyst retained its activity for the 50 injections without any loss of pressure.
Fig. S2 Pressure-Time curve in a batch reactor for a HAN-(CeCo 26) catalyst system for 50 injections.

**XRD:**

Table S1 Effect of dopant on ceria phase distribution, crystallite size (D), inter-planar spacing (d-spacing), and cell parameter (a).

<table>
<thead>
<tr>
<th>Samples</th>
<th>Phases</th>
<th>Peak</th>
<th>2θ (degrees)</th>
<th>D (nm)</th>
<th>d-spacing (Å)</th>
<th>a (Å)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure CeO₂</td>
<td>CeO₂</td>
<td>111</td>
<td>28.49</td>
<td>45.6</td>
<td>3.129</td>
<td>5.420</td>
</tr>
<tr>
<td>CeCo 2</td>
<td>CeO₂</td>
<td>111</td>
<td>28.50</td>
<td>50.1</td>
<td>3.128</td>
<td>5.417</td>
</tr>
<tr>
<td>CeCo 15</td>
<td>CeO₂</td>
<td>111</td>
<td>28.38</td>
<td>52.9</td>
<td>3.141</td>
<td>5.440</td>
</tr>
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<td></td>
<td>Co₃O₄</td>
<td>311</td>
<td>36.69</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CeCo 20</td>
<td>CeO₂</td>
<td>111</td>
<td>28.49</td>
<td>51.6</td>
<td>3.129</td>
<td>5.419</td>
</tr>
<tr>
<td></td>
<td>Co₃O₄</td>
<td>311</td>
<td>36.79</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CeCo 26</td>
<td>CeO₂</td>
<td>111</td>
<td>28.50</td>
<td>51.0</td>
<td>3.128</td>
<td>5.418</td>
</tr>
<tr>
<td></td>
<td>Co₃O₄</td>
<td>311</td>
<td>36.80</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CeCo 26x</td>
<td>CeO₂</td>
<td>111</td>
<td>28.48</td>
<td>48.8</td>
<td>3.130</td>
<td>5.421</td>
</tr>
<tr>
<td></td>
<td>Co₃O₄</td>
<td>311</td>
<td>36.79</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CeCo 28</td>
<td>CeO₂</td>
<td>111</td>
<td>28.51</td>
<td>47.3</td>
<td>3.127</td>
<td>5.416</td>
</tr>
<tr>
<td></td>
<td>Co₃O₄</td>
<td>311</td>
<td>36.80</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table S2 Comparison of Thermally aged CeCo 26 with pristine CeCo 26 using crystallite parameters.

<table>
<thead>
<tr>
<th>Samples</th>
<th>Phases</th>
<th>Peak</th>
<th>2θ (degrees)</th>
<th>D(nm)</th>
<th>d-spacing (Å)</th>
<th>a (Å)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeCo 26</td>
<td>CeO₂</td>
<td>111</td>
<td>28.49977</td>
<td>50.985</td>
<td>3.128</td>
<td>5.418</td>
</tr>
<tr>
<td></td>
<td>Co₃O₄</td>
<td>311</td>
<td>36.79967</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
**XPS:** The Co content of the samples could be obtained by XPS but in this paper the values of area obtained by Co 2p are highly unreliable as noise to signal ratio is fairly high (Fig. 4c) which has been pointed out in XPS studies. The values obtained via XPS for Co:Ce ratio are given below in Table;

<table>
<thead>
<tr>
<th>Sample</th>
<th>Ce : Ce ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeCo 20</td>
<td>6 : 94</td>
</tr>
<tr>
<td>CeCo 26</td>
<td>7 : 93</td>
</tr>
<tr>
<td>CeCo 26x</td>
<td>5.5 : 94.5</td>
</tr>
<tr>
<td>CeCo 28</td>
<td>13:87</td>
</tr>
<tr>
<td>CeCo 26_annealed at 1400°C</td>
<td>8:92</td>
</tr>
</tbody>
</table>

Though absolute values of cobalt content are different in both XPS and EDS studies, there appears to be a relation. The values obtained in XPS are 2-2.5 times smaller than the value estimated from EDS studies (Table 3), probably due to different means of technique.