Advanced photocatalytic properties of ZnO thin films prepared by plasma enhanced ALD
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Goals

- Study of photocatalytic activity of ZnO thin films prepared by thermal and plasma enhanced Atomic Layer Deposition (ALD)
- The photocatalytic degradation studies of methyl orange (MO) in the presence of ZnO thin films
- Difference in photocatalytic properties of thermal and PE-ALD made ZnO thin films

Experimental methods

ALD synthesis of ZnO thin films

<table>
<thead>
<tr>
<th>ALD process</th>
<th>Thermal ALD</th>
<th>PE-ALD</th>
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</thead>
<tbody>
<tr>
<td>Precursors in ALD</td>
<td>diethyl zinc + H₂O</td>
<td>diethyl zinc + O₂ plasma</td>
</tr>
<tr>
<td>Temperature of deposition</td>
<td>100 °C</td>
<td>100 °C</td>
</tr>
<tr>
<td>Number of ALD cycles</td>
<td>634</td>
<td>415</td>
</tr>
<tr>
<td>Thickness of ZnO</td>
<td>100 nm</td>
<td>100 nm</td>
</tr>
<tr>
<td>Dimension of silicon substrate</td>
<td>0.7 cm × 0.7 cm</td>
<td>0.7 cm × 0.7 cm</td>
</tr>
</tbody>
</table>

Measurements

- Experiments were preformed “in-situ” – in quartz cuvettes with light path of 10 mm.
- ZnO thin films were irradiated by two UV lamps of different strengths
- For measurement done with Intelli-Ray 600 UV oven was used MO solution of c = 2.425 · 10⁻³ g/L.
- For measurements done with CAMAG UV Lamp 4 strenght 8 W and wavelength of 254 nm was used MO solution of c = 1.21 · 10⁻³ g/L.
- The time dependent degradation process of MO in aqueous solution was monitored by Agilent Technologies Cary 60 UV/Vis spectrophotometer and analysed in QtiPlot.

References


Conclusion

- ZnO thin films successfully photodegraded MO in solution which show their photocatalytic activity.
- Significant increase in MO degradation rate when ZnO thin films prepared by PE-ALD were used as photocatalysts. This indicates that the plasma process induces the formation of a higher amount of electron-hole pairs on ZnO active surface which are responsible for the generation of reactive radicals and, consequently, enhanced photo-oxidation ability of PE-ALD made ZnO thin films.