**INTRODUCTION**

The importance of TiO₂ nanostructures in sensors, photocatalysis or photovoltaics can’t be overemphasized. Hydrothermal method of synthesis offers a process in which TiO₂ can be grown from solution. This method is quite interesting because of the option to use solvents, reagents and Ti compounds of choice. Additives can also be added in addition to free choice of temperature value and reaction time to obtain desired structure. Hydrothermal synthesis is carried out in an autoclave: a closed system.

**OBJECTIVE**

To grow/synthesize TiO₂ nanostructures with optimal active surface area for dye adsorption and electron transport properties to achieve DSSC devices.

**EXPERIMENTAL**

**Substrate (FTO) Preparation**

- Cleaning by sonication
- Blocking layer on substrate by dip coating
- Crystallisation

**Hydrothermal/Solvothermal Process**

- Teflon-lined Autoclave
- Solvents + Ti compound
- Oven treatment @ set Temp & Time

**TiCl₄ Treatment**

- Thermal Treatment
- Dye Impregnation

**DSSC Assembly and Analysis**

- HTM Infiltration
- Deposition of counter electrode
- IV measurements by solar simulator

**SEM of NS: from Organic + Water**

- 6 h @180°C
- 9 h @180°C
- 6 h @200°C
- 9 h @200°C

Temperature and time of reaction have direct impact on morphology and thickness. In general, at high temperatures, after a given time, the thickness of NS begin to reduce by re-dissolving in solution.

**SEM of NS: from Organic + Acid**

- 9 h @150°C
- 6 h @180°C
- 9 h @180°C
- 6 h @180°C

Morphology becomes well defined and stable with relatively high temperature. Thickness reduces at prolonged reaction time due to re-dissolving at the interface with solution.

**XRD ANALYSIS**

- XRD analysis revealed anatase polymorph for nanostructures grown in contact with solution in the presence of hydroxyl ions.
- XRD analysis revealed rutile polymorph for nanostructures grown in contact with solution in the presence of chloride ions.

**Surface Area Analysis by UV-VIS**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Thickness (µm)</th>
<th>Surface Area of NS (cm²)</th>
<th>Specific Surface Area N719/ Vol. TiO₂ (m²/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.77</td>
<td>7.20</td>
<td>54.95</td>
</tr>
<tr>
<td>B</td>
<td>1.39</td>
<td>6.90</td>
<td>150.51</td>
</tr>
<tr>
<td>C</td>
<td>1.15</td>
<td>6.90</td>
<td>146.66</td>
</tr>
<tr>
<td>D</td>
<td>1.31</td>
<td>7.20</td>
<td>154.86</td>
</tr>
<tr>
<td>E</td>
<td>1.17</td>
<td>6.69</td>
<td>136.43</td>
</tr>
</tbody>
</table>

- NS grown in acid/organic have high specific surface area. This is highly dependent on the temperature and time of hydrothermal synthesis.
- NS grown in contact with organic solution have insignificant specific surface area with respect to the ruthenium complex dyes.

**Conclusion**

TiO₂ nanostructures as directly synthesized on conducting glass by hydrothermal method showed increased specific surface area. The conditions of synthesis are to be optimized for improved electron transport properties.

**Acknowledgement**

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