Synthesis and Characterization of C-TiO_2 nanotubes using a template-assisted sol-gel technique

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Background

- The solar energy that the earth receives in one hour, is said to be sufficient to meet the total energy demand of the world for more than one year.

- Harvesting solar energy into electricity using photovoltaic cells has become one of the most promising solution to modern energy issues, mainly because solar energy is produced without carbon-emission .

- The development of alternative energy sources has been motivated by health problems, environmental concerns.

Introduction

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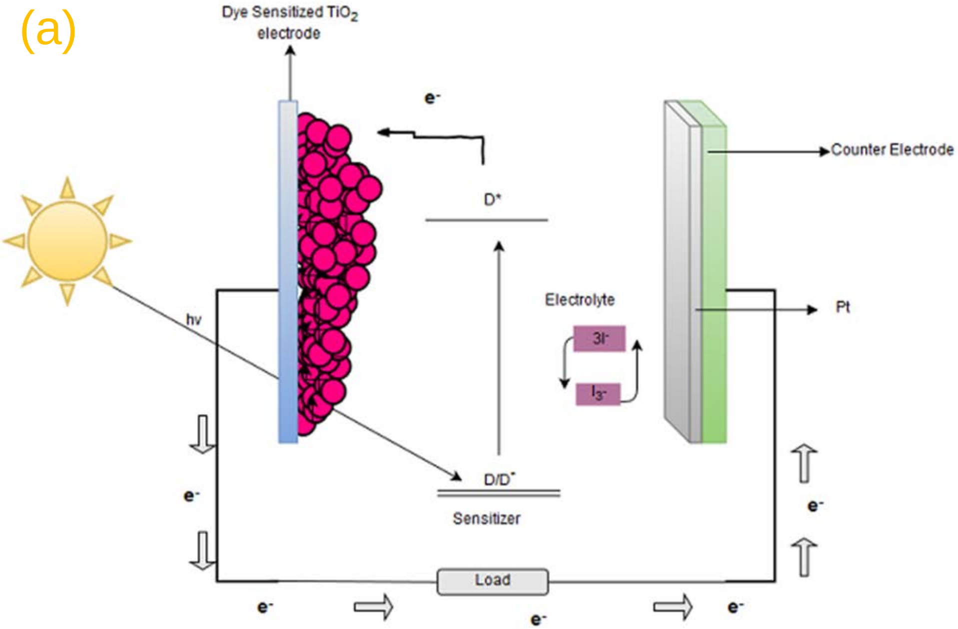
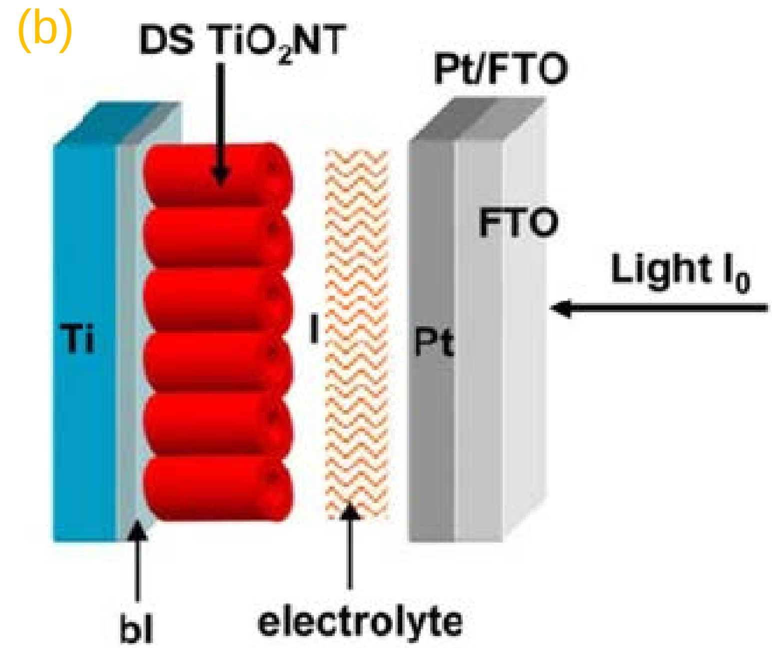
- In 1991, Switzerland Professor Michael Grätzel and Dr Brian O' Regan devised Dye Sensitized Solar Cells (DSSC), also referred to as Dye Sensitized Cells (DSC) or Grätzel Cell.

- These cells are a third generation photovoltaic (solar) cell that convert any visible light into electrical energy, they which seek to mimic a part of the photosynthetic process [6].

- DSSC currently have an efficiency of 13 %.

Background





DSSC, with TiO2 NPs.

- High electro-hole recombination.
- Hoping mechanism for transport of electrons.
- Poor collection of photon generated electrons.
- Long diffusion pathway of electrons.
- Low efficiencies.

DSSC, with TiO2 TNTs.

- Improved electron transport.
- Vectorial charge transfer of electrons.
- Enhanced collection of photon generated electrons & short diffusion pathway of electrons
- Improved efficiencies..

Aim and Objectives

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Aim

- Synthesis and Characterization of un-doped and carbon doped TiO_2 nanotubes using template-assisted sol-gel technique.

Objectives

- Synthesis of undoped and carbon doped TiO_2 sol-gel precursor solutions.
- Synthesis of undoped and carbon doped TiO_2 nanotubes using AAM templates.
- Structural/ morphological and elemental characterization of undoped and carbon doped TiO_2 nanotubes using SEM, SEM-EDX, FTIR, XRD and confocal Raman spectroscopy.

Methodology

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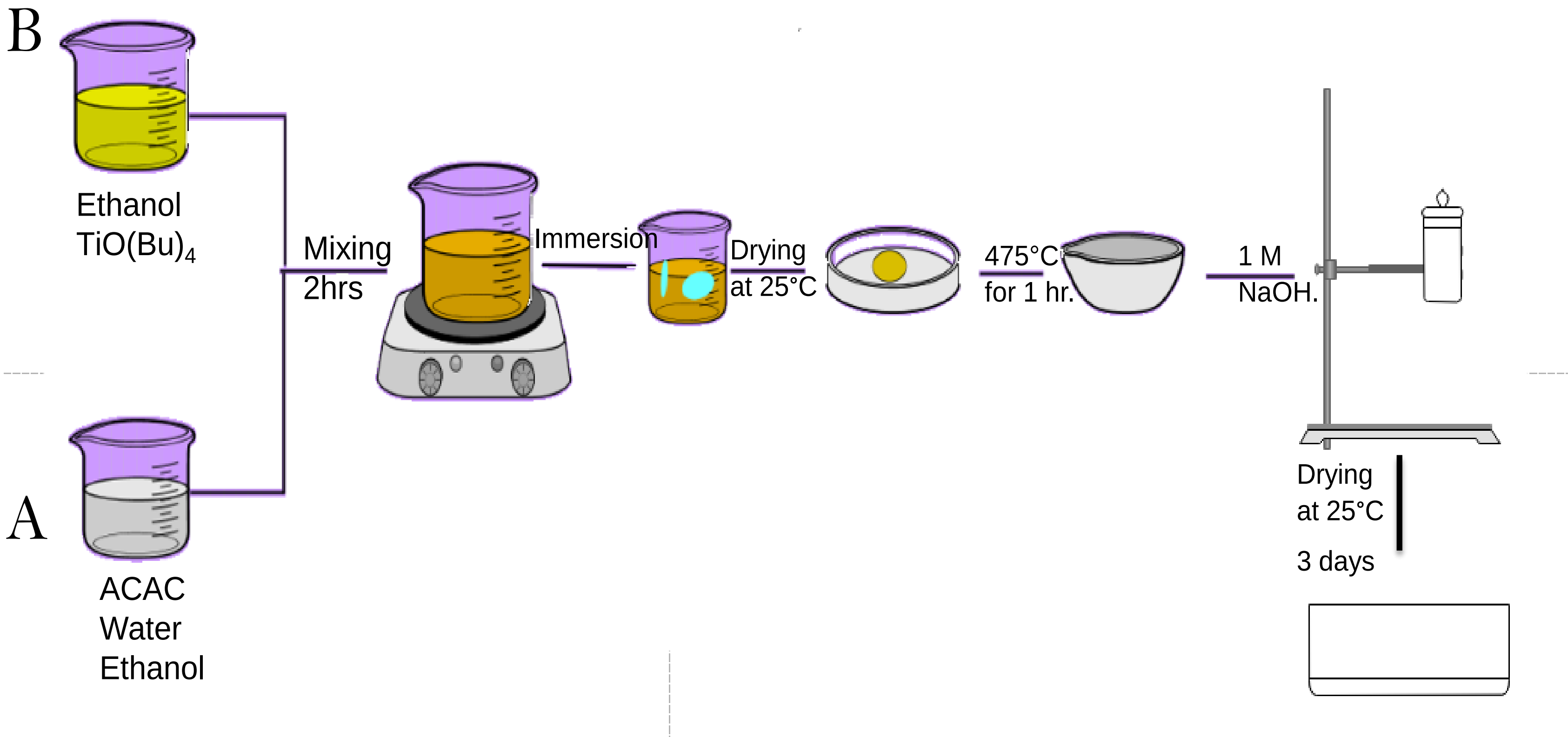

Results : SEM

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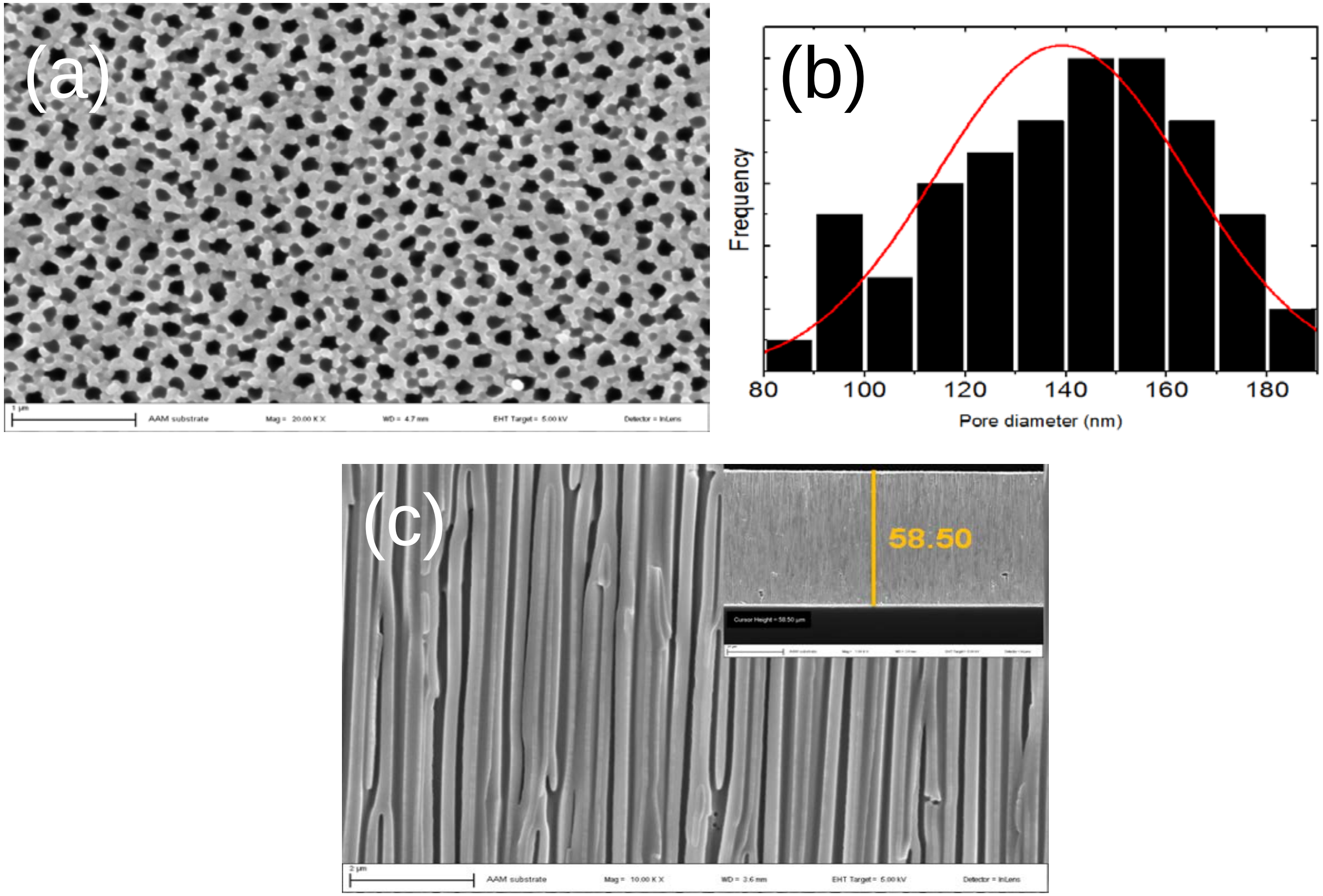
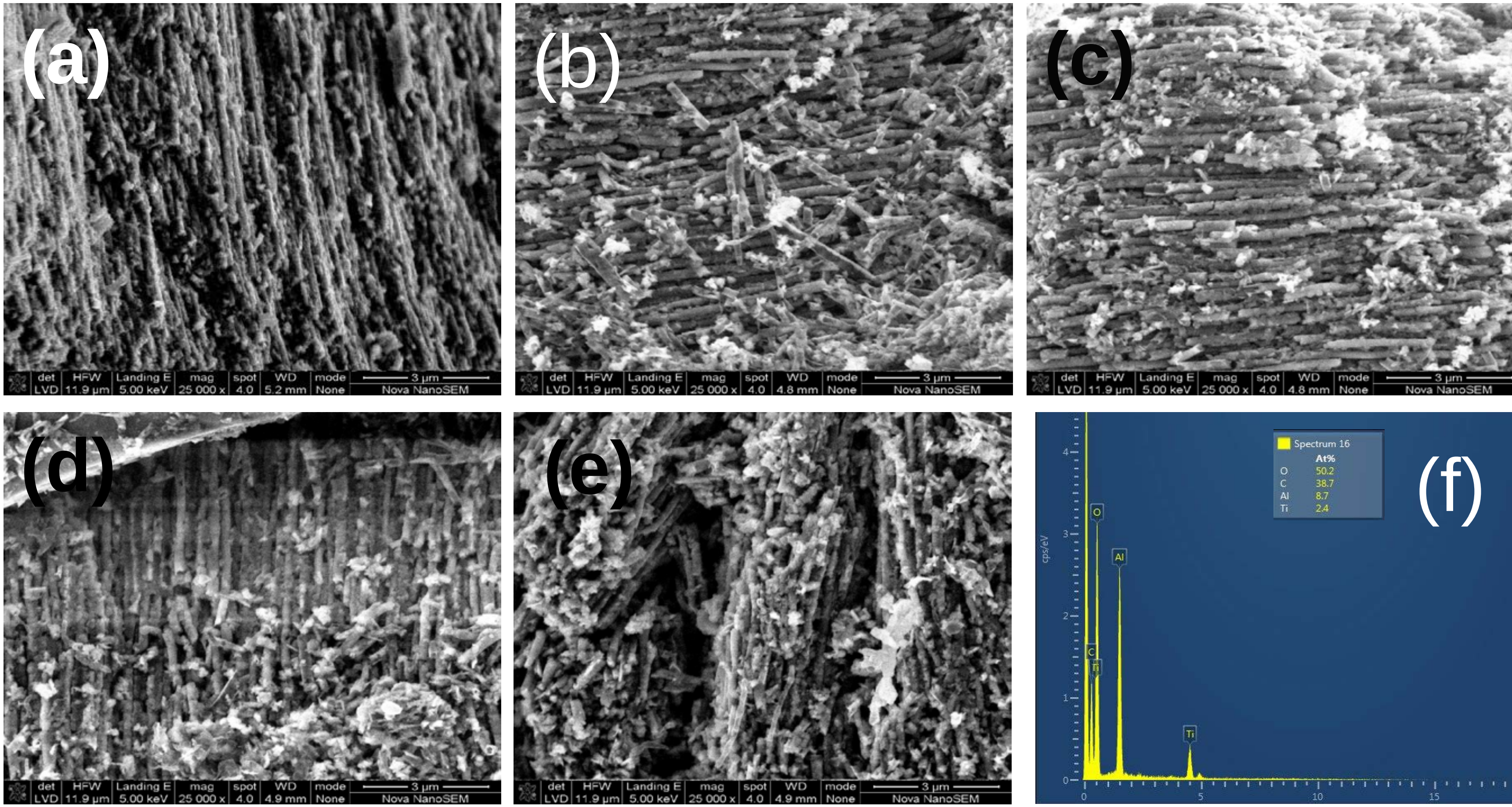


- Surface SEM analysis has revealed a pore size range of 80-180 nm

- Cross sectional SEM analysis has revealed AAM of length range of 57.15 -59.9 µm

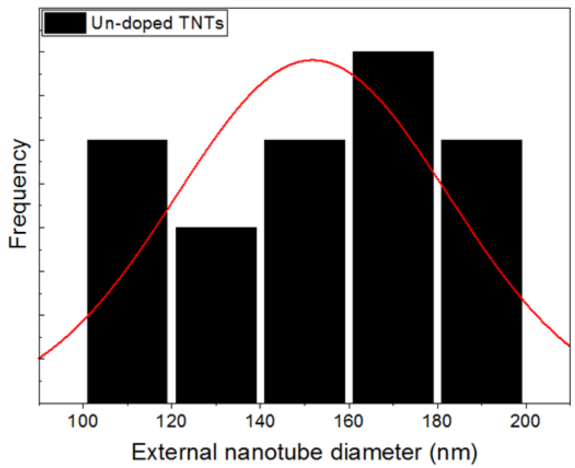
(a) Surface morphology of AAM's , (b) Histogram for pore diameter size and (c) Cross sectional SEM of AAM's

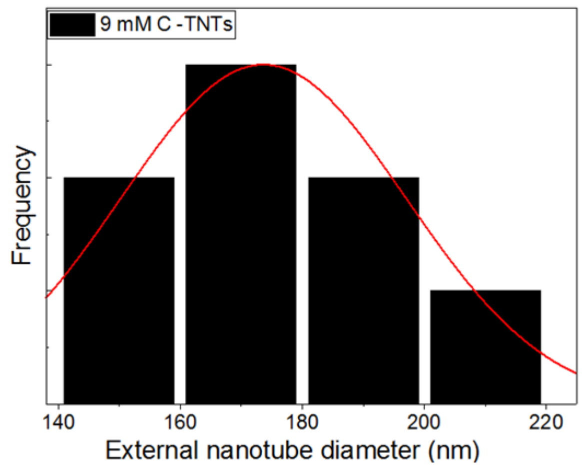
Results : SEM

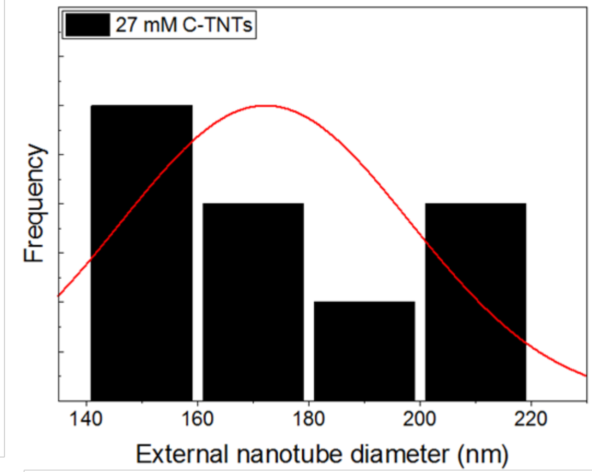


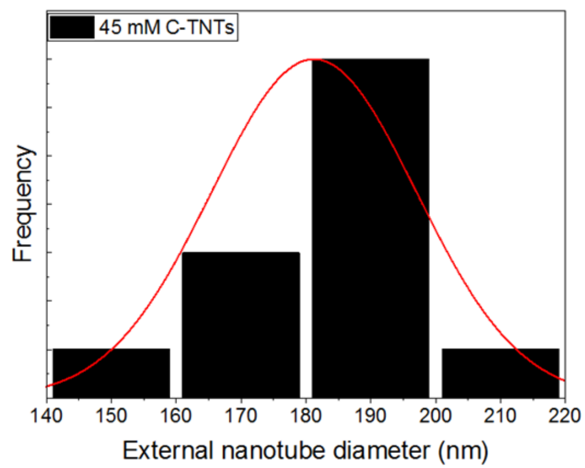
Cross sectional SEM (a) Undoped TNTs, (b) 9 mM C-TNTs, (c) 27 mM C-TNTs , (d) 45 mM C-TNTs , (e) 75 mM C-TNTs and (f) EDX of TNTs.

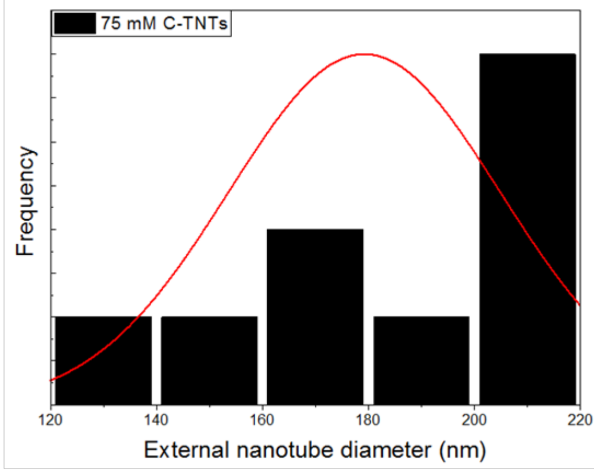
Results : SEM











Pore diameter is consistent to the pore diameter of TNTs.

Pore diameter of TNTs synthesized by a template-assisted sol-gel technique

Results : FTIR

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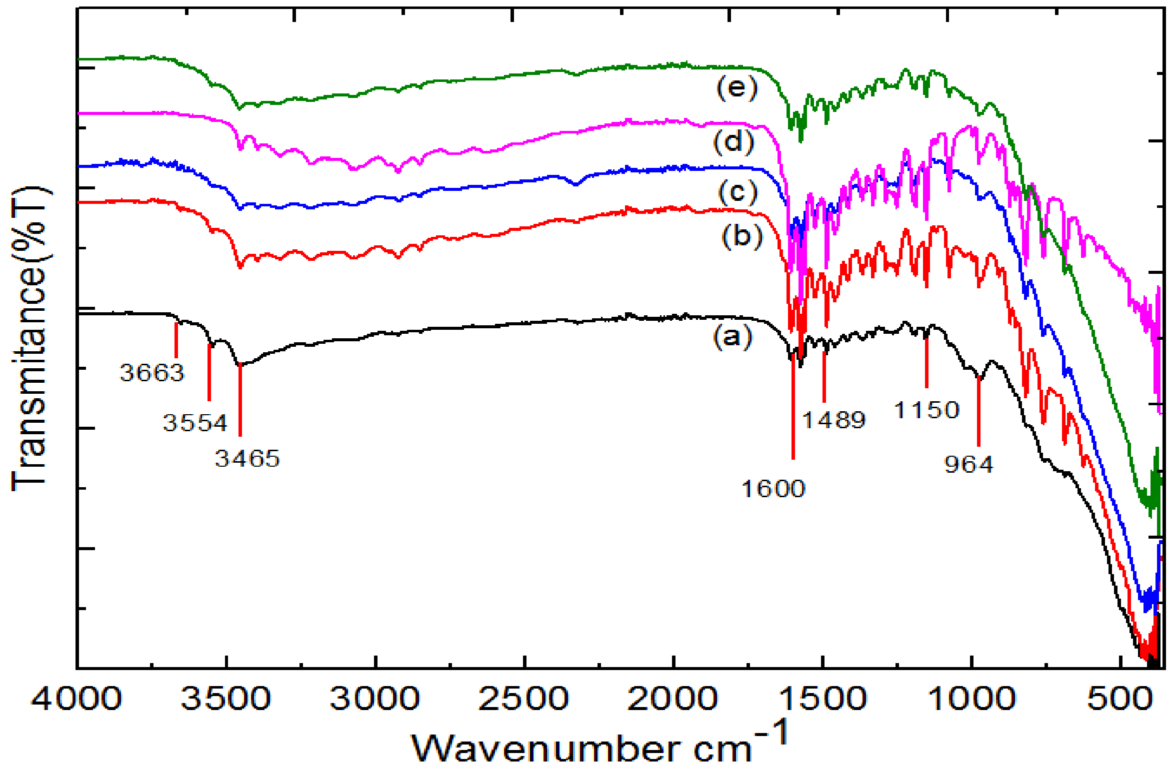

- **Ti-O-O 460 1/cm**
- O-H 3100-36001/cm

FTIR results for (a) un-doped TNTs, (b) 9mM C-TNTs (c) 27mM C-TNTs (d) 45 mM C-TNTs and (e) 75 Mm C-TNTs.

Results : XRD

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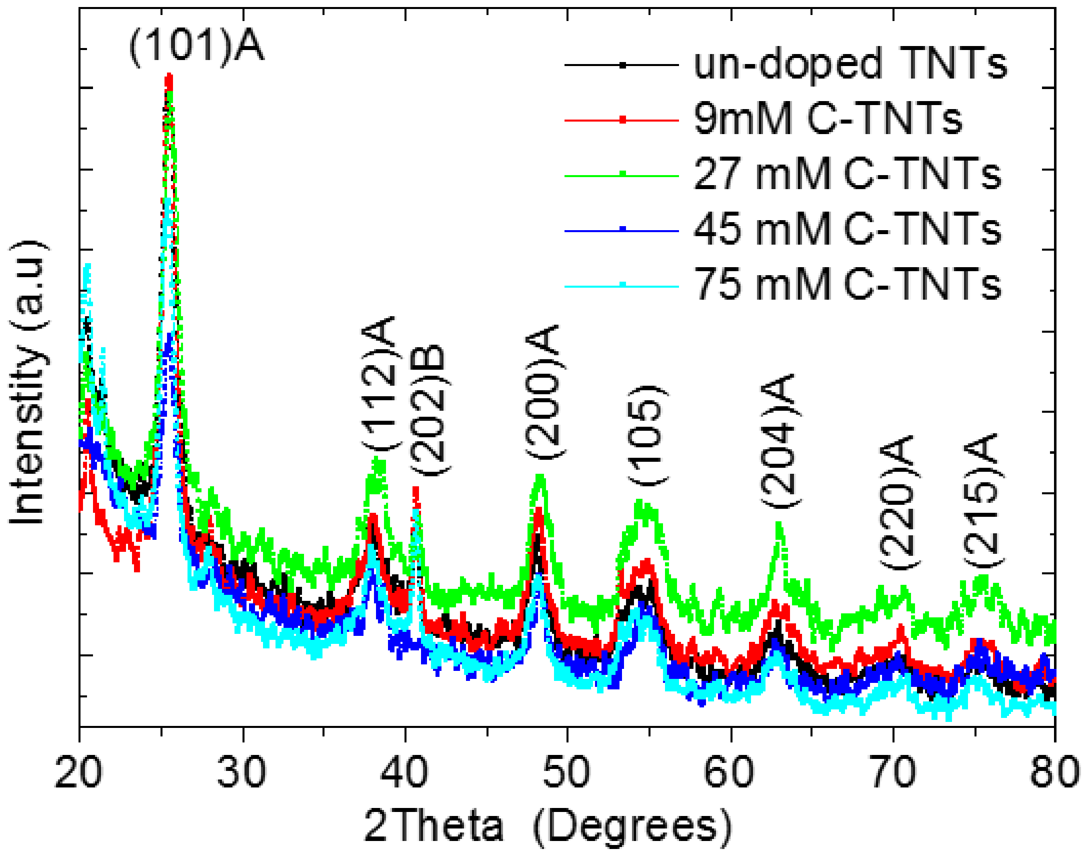

- Peaks arise from Anatase (JCPDS No. 21- 1272).
- Diffraction peak at 40.60° for arises from [202] crystal plane of Brookite phase of TiO2 (JCPDS No. 29-1360 TiO2).

Powder X-ray diffraction analysis of un-doped and C-TNTs fabricated by a template-assisted sol-gel technique

Results : XRD

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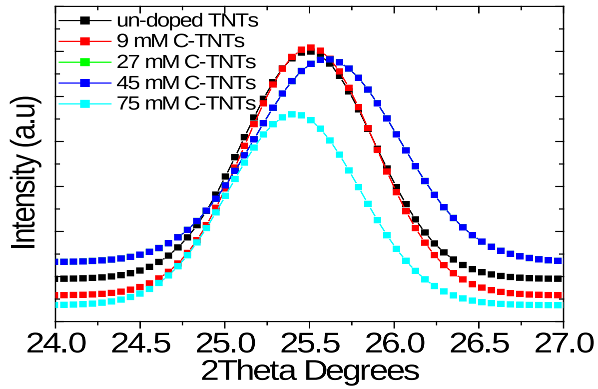
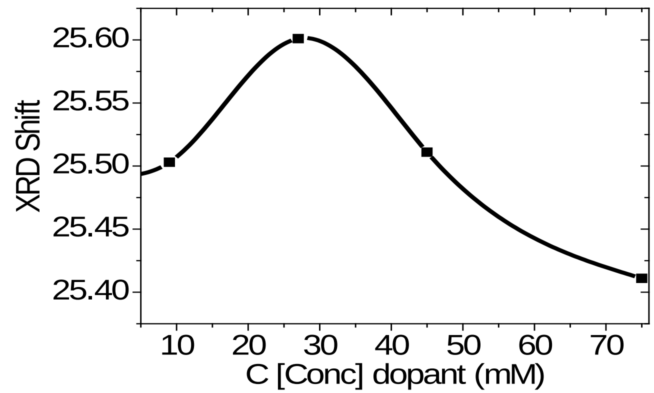
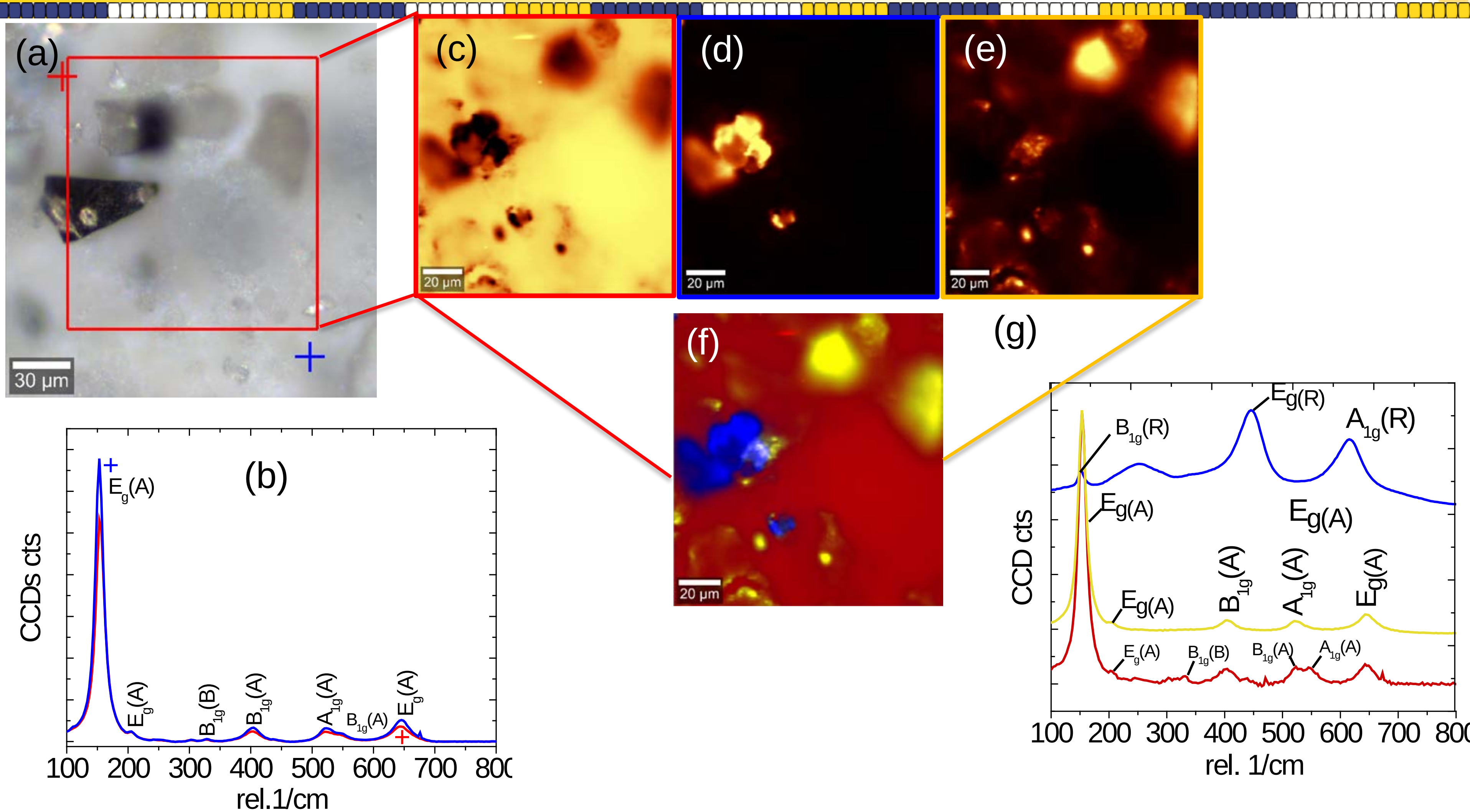




	(101) *d* spacing (Å)	Lattice parameters (Å) *a*	*c*
Bulk Anatase	3.520	3.784	9.514
un-doped TNTs	3.490	3.761	9.143
9mM C-TNTs	3.489	3.769	9.197
27mM C-TNTs	3.476	3.742	9.461
45 mM C-TNTs	3.488	3.752	9.809
75 mM C-TNTs	3.501	3.742	9.830

Results: CRM-LAS



Results: CRM-LAS

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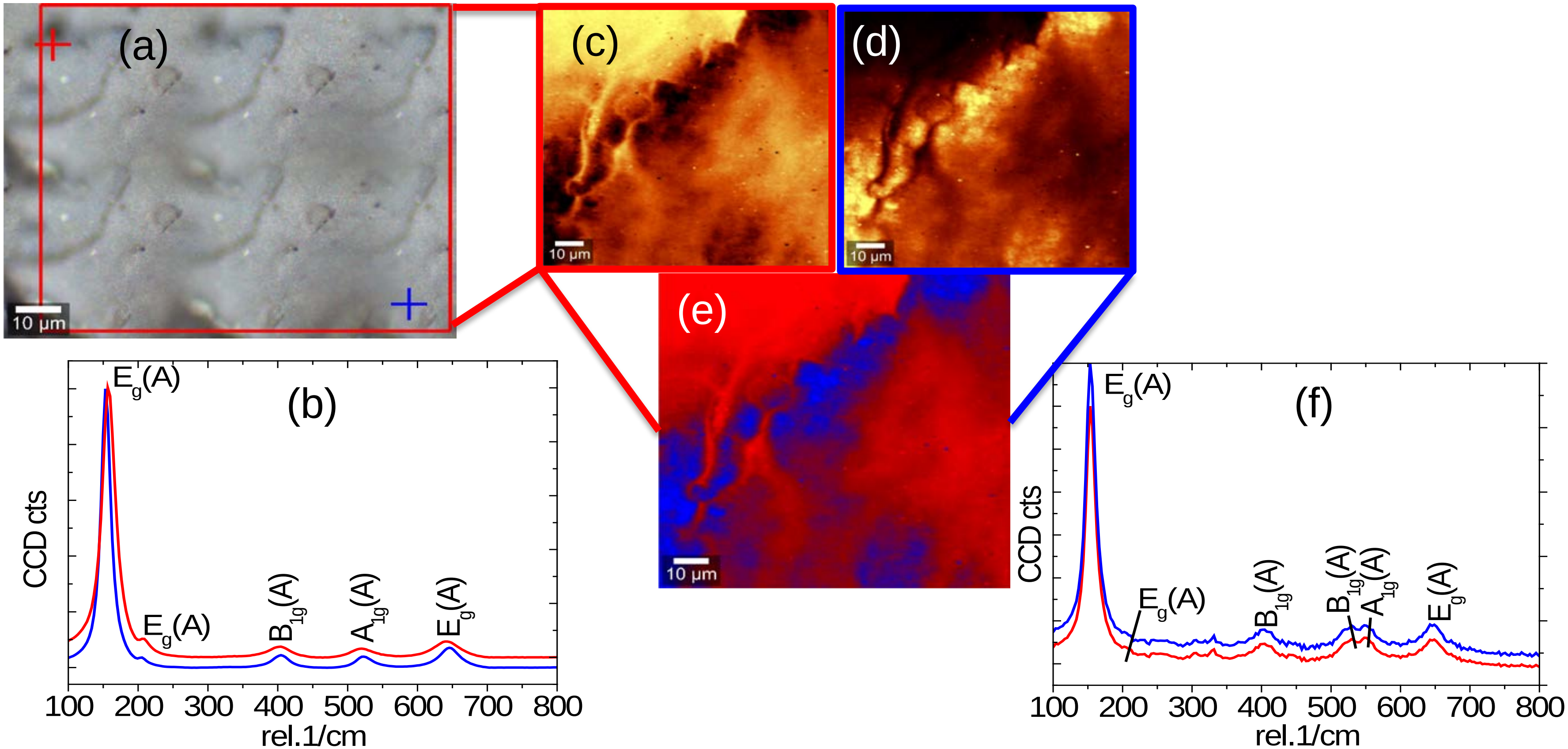

CRM-LAS(a) video image (b) Raman single spectra (c) & (d) draw images showing phase distribution of TiO_2 (e) Is a combined image and (f) shows the corresponding colour coded spectr of (e).

Results: CRM-Depth Profiling

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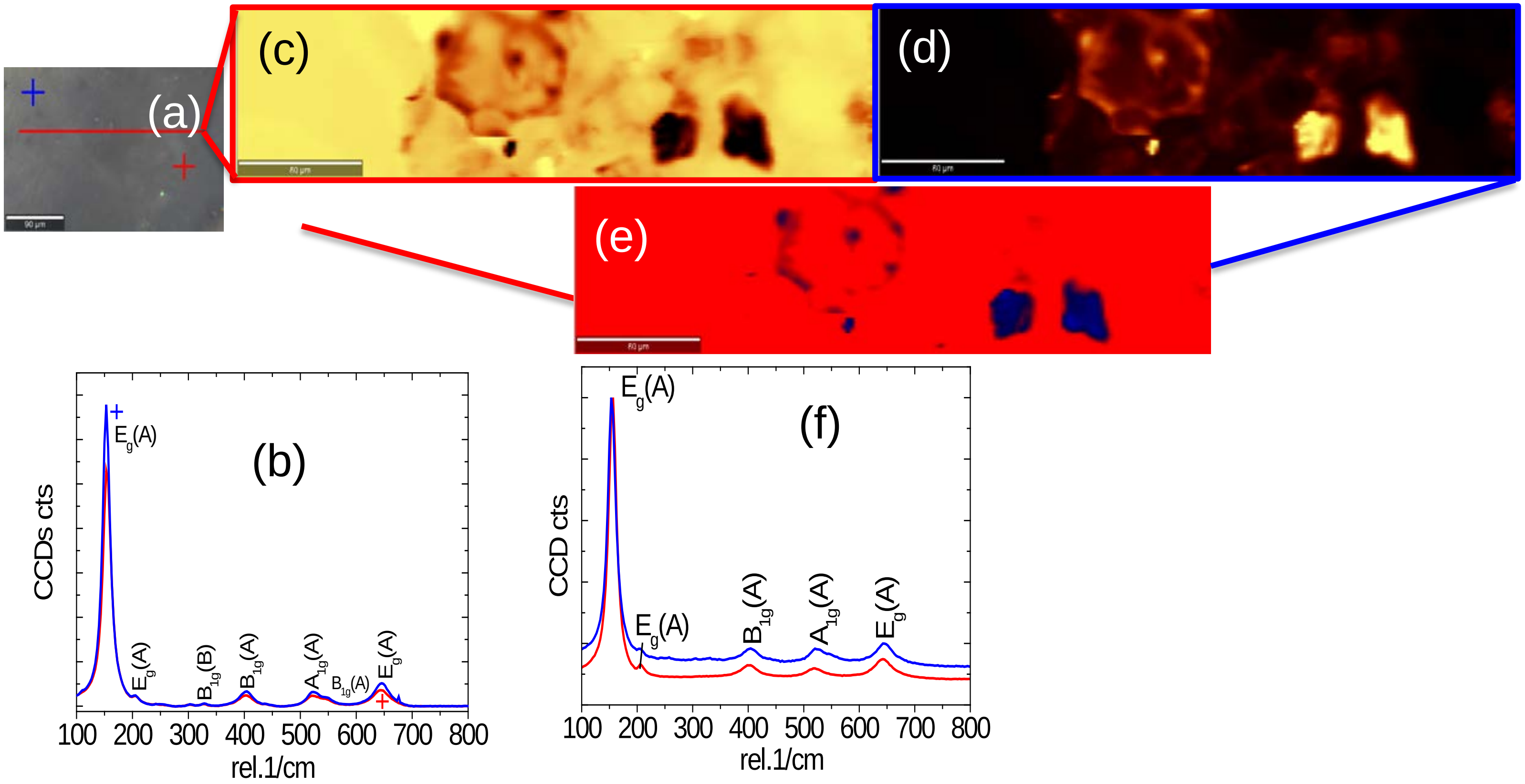

CRM-Depth profiling(a) video image (b) Raman single spectra (c) & (d) draw images showing phase distribution of TiO_2 (e) Is a combined image and (f) shows the corresponding colour coded spectra of (e).

Results: CRM-Depth Profiling

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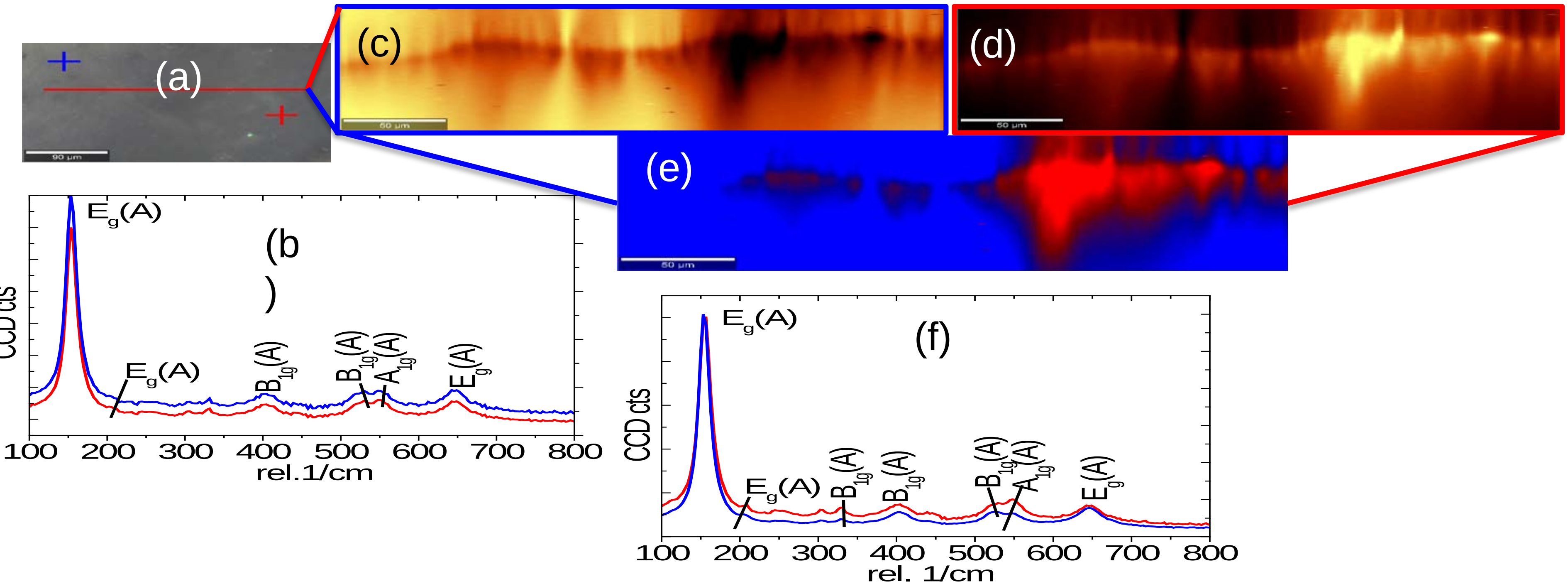

CRM-Depth profiling(a) video image (b) Raman single spectra (c) & (d) draw images showing phase distribution of TiO_2 (e) Is a combined image and (f) shows the corresponding colour coded spectra of (e).

Conclusion

- SEM revealed presence of TNTs and changes in surface morphology as the dopant concentration increase.
- SEM-EDX revealed presence of strong Ti and O signals.
- FTIR confirmed the presence of Ti-O bond at 480 1/cm.
- XRD revealed the presence of Anatase and Brookite.
- XRD has shown increase in lattice constant "c" with increase in dopant concentration.
- CRM-LAS and CRM-depth profile confirmed presence of Brookite and Anatase

Acknowledgements

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THANK YOU FOR YOUR TIME AND ATTENTION!!!!