

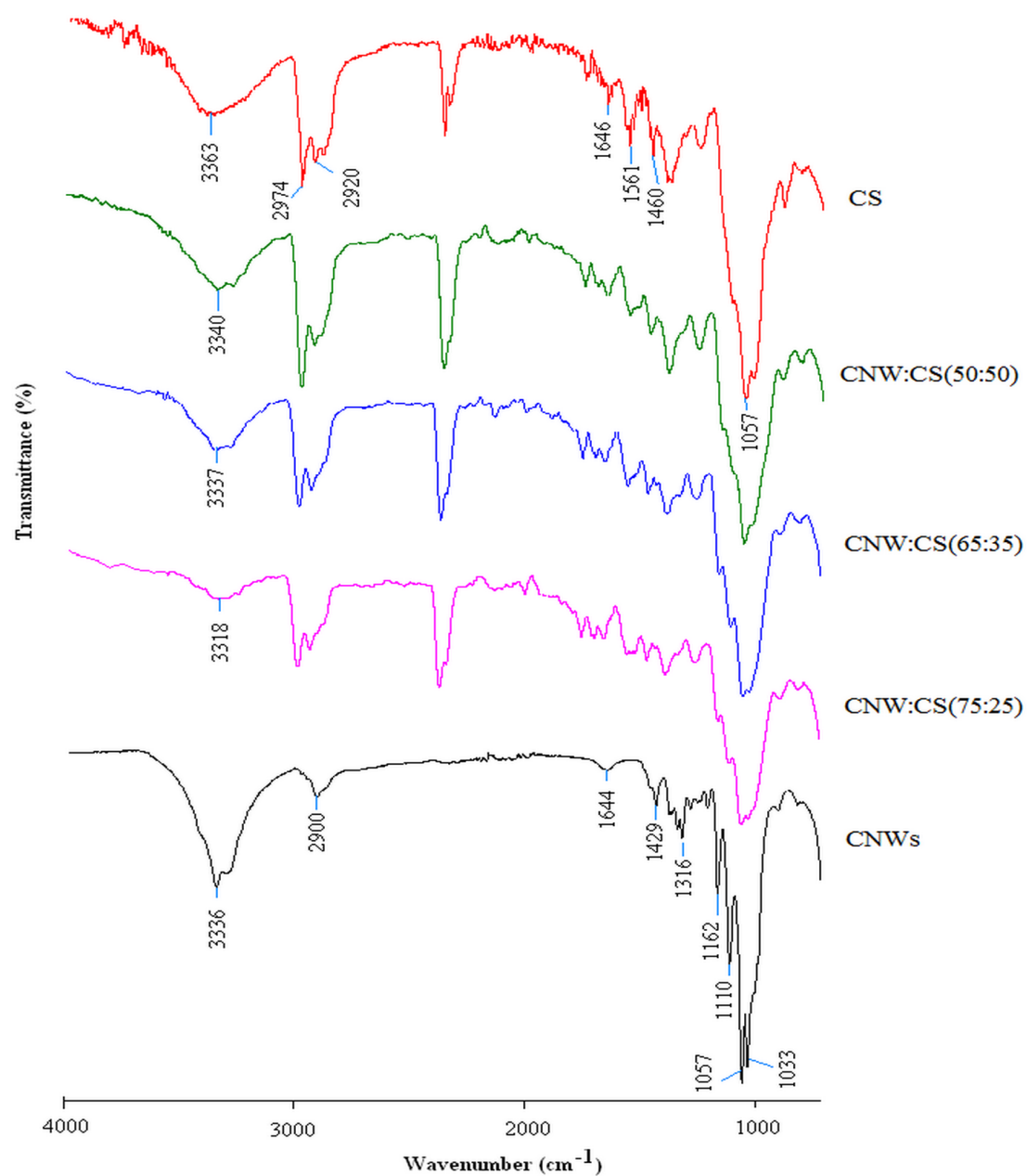
## **List of Electronic Supplementary Information (ESI)**

**ESI 1** FTIR-ATR spectrum of CNWs, CS and CNW-CS flexible films

**ESI 2** FTIR-ATR vibrational frequency (% transmittance) of CNWs, CS and CNW-CS flexible films

**ESI 3** Surface roughness profile of the thin flexible films: **a)** CS, **b)** CNW:CS(50:50), **c)** CNW:CS(65:35) and **d)** CNW:CS(75:25).

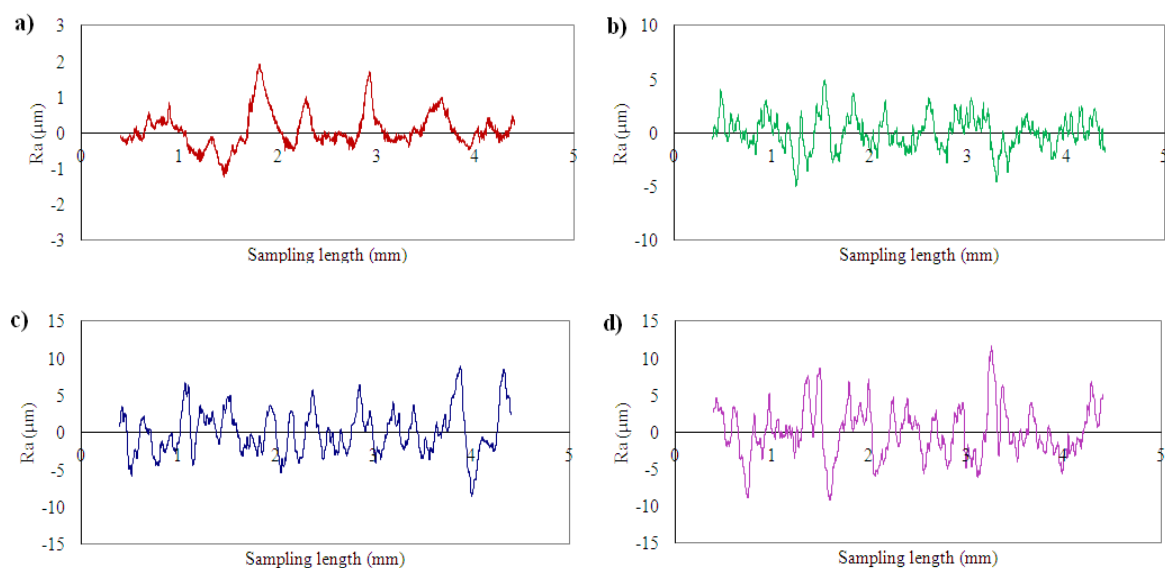
**ESI4** 2DTG curves of CNWs, CS and CNW-CS flexible films



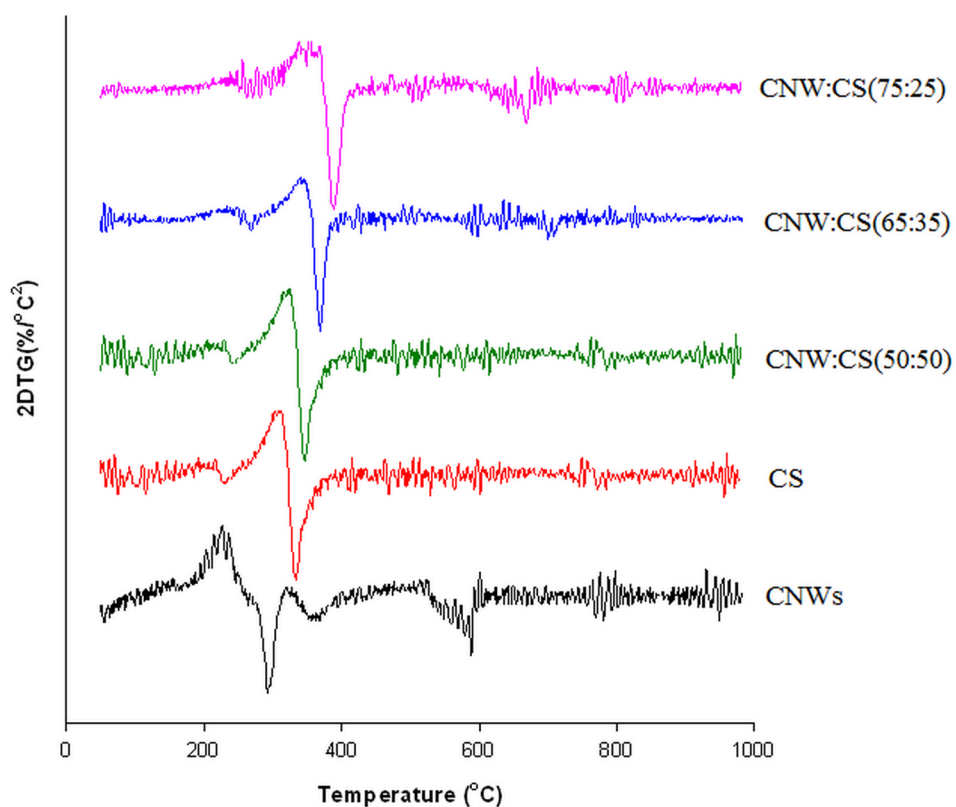
**ESI 1** FTIR-ATR spectrum of CN, CS and CN-CS flexible films

**ESI 2** FTIR-ATR vibrational frequency (% transmittance) of CNWs, CS and CNW-CS flexible films

| <b>Functional groups<br/>(types of vibration)</b>          | <b>CNWs<br/>(cm<sup>-1</sup>)</b> | <b>CS<br/>(cm<sup>-1</sup>)</b> | <b>CNW:CS<br/>(50:50)<br/>(cm<sup>-1</sup>)</b> | <b>CNW:CS<br/>(65:35)<br/>(cm<sup>-1</sup>)</b> | <b>CNW:CS<br/>(75:25)<br/>(cm<sup>-1</sup>)</b> | <b>References</b> |
|------------------------------------------------------------|-----------------------------------|---------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------|
| –OH (free)<br>(stretching)                                 | 3336                              | 3363                            | 3340                                            | 3337                                            | 3318                                            | 34, 57            |
| C-H<br>(stretching of<br>CH <sub>2</sub> group)            | 2900                              | 2920                            | 2920                                            | 2920                                            | 2922                                            | 57, 58            |
| –OH (adsorbed)<br>(bending)                                | 1644                              | 1646                            | -                                               | -                                               | -                                               | 54, 58            |
| –COO<br>(asymmetric<br>stretching)                         | -                                 | 1561                            | 1550                                            | 1550                                            | 1549                                            | 57                |
| C-H<br>(asymmetric<br>stretching of –<br>CH <sub>3</sub> ) | -                                 | 1460                            | 1462                                            | 1462                                            | 1462                                            | 11                |
| C-H<br>(bending of –<br>CH <sub>2</sub> )                  | 1429                              | -                               | -                                               | -                                               | -                                               | 34                |
| C-O<br>(stretching in<br>saccharide<br>structure)          | 1057                              | 1057                            | 1058                                            | 1050                                            | 1050                                            | 33, 57            |



**ESI 3** Surface roughness profile of the thin flexible films: **a)** CS, **b)** CNW:CS(50:50), **c)** CNW:CS(65:35) and **d)** CNW:CS(75:25).



**ESI 4** 2DTG curves of CN, CS and CN-CS flexible films.