# CHAPTER 4

# Conclusion

## 4.1 Synthesis of CMC-$AgInS_2$ QDs

CMC-$AgInS_2$ QDs were successfully synthesized by hydrothermal method at relatively low temperature and short reaction time. Silver nitrate, indium nitrate, thioacetamide, sodium thiosulfate pentahydrate, L-cystein, and carboxymethyl cellulose sodium salt were used as the starting precursors. The products, controlled by synthetic conditions, were composed of a number of very tiny crystals in the shapes of nanorods, nanosheets, nanoplates and nanospheres.

## 4.2 Characterization

CMC-$AgInS_2$ QDs were synthesized by hydrothermal method. Single phase with orthorhombic phase of $AgInS_2$ nanocrystals was obtained 200 °C for 24 h. The range of hydrodynamic size of the CMC-$AgInS_2$ QDs synthesized by hydrothermal was 200 – 300 nm. The chemical states of element composed the CMC-$AgInS_2$ QDs were C, O, $Ag^{+}$, $In^{3+}$, and $S^{2-}$. CMC was successfully coated onto the surface of $AgInS_2$ QDs to form CMC-$AgInS_2$ QDs. Vibration peaks at around 1609 and 1408 $cm^{-1}$ are attributed to the stretching vibration of the carboxylate groups ($COO^{-}$). The percentage of CMC on CMC-$AgInS_2$ QDs is approximately 5%. The measured band gap energy of CMC-$AgInS_2$ QDs was found to be 3.92 to 3.98 eV.

## 4.3 Drug Encapsulation Studies

The average of size of the CMC-$AgInS_2$ QDs synthesized by hydrothermal was 10 nm with spherical shape. The product is size less than 200 nm with a spherical shape and a smooth texture. Therefore, the products was easily transport through cancer vasculature

in into cancer cells. The DOX entrapping efficiency (%DEE) and DOX loading efficiency (%DLE) were determined to be 50% and 14%, respectively.

### 4.4 Cellular Uptake of CMC-$AgInS_2$ QDs

The intracellular uptake of CMC-$AgInS_2$ QDs can be observed *via* its green fluorescence. Intracellular uptake of DOX-loaded CMC-$AgInS_2$ QDs and free DOX was also observed *via* intrinsic red fluorescence of doxorubicin. It was found that DOX fluorescence was not only observed in the cells treated with free DOX but also DOX-loaded CMC-$AgInS_2$ QDs, indicating efficient delivery of drug molecules by CMC-$AgInS_2$ QDs.

### 4.5 Biocompatibility Studies

The biocompatibility of CMC-$AgInS_2$ QDs was proved by the viability of 87 % with MCF7 in MTT assay at high concentration of CMC-$AgInS_2$ QDs (0.26 mg/ml). The CMC-$AgInS_2$ QDs have good biocompatibility.

### 4.6 Cytotoxicity Studies

The CMC-$AgInS_2$ QDs demonstrate lower percent cell viability in comparison with the free-DOX, which render them particularly suitable for biological applications.