

Electronic Supplementary Information (ESI)

Chiral Carbon Dots and its Effect on the Optical Properties of Photosensitizer

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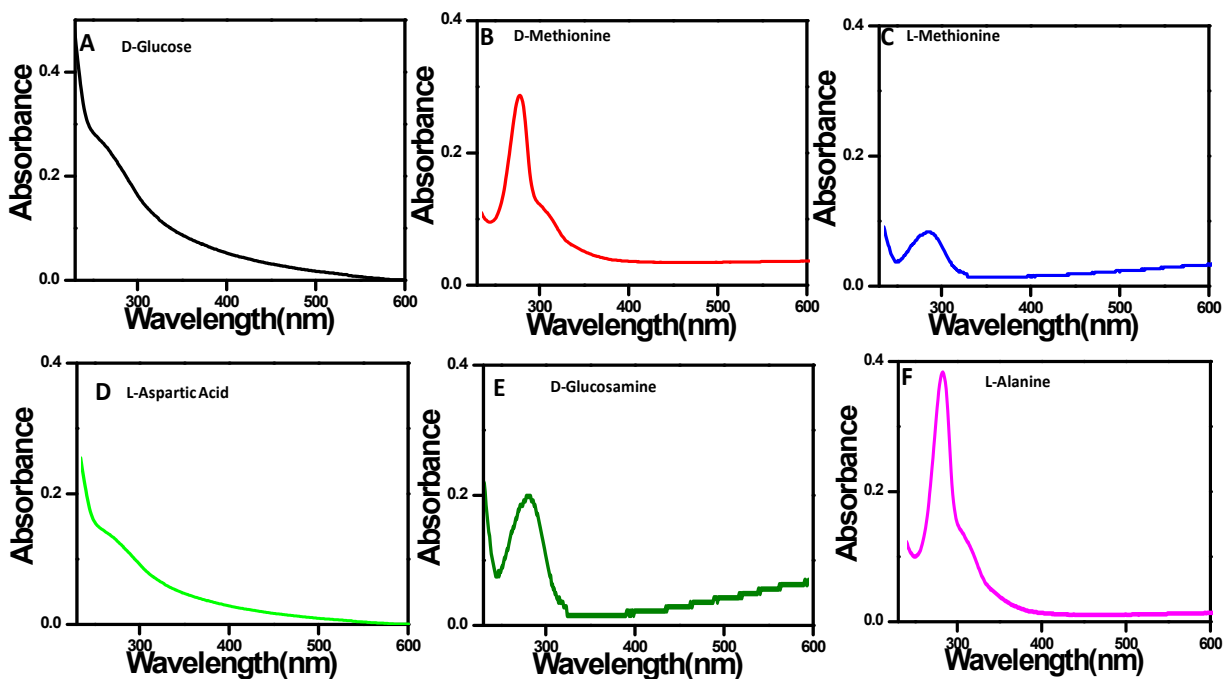


Fig. ESI1. UV-Visible spectra of A) D-Glucose, B) D-Methionene, C) L-Methionene, D) L-Aspartic Acid, E) D-Glucosamine and F) L-Alanine

The precursor's molecules were characterized using UV-Visible spectroscopy. It is evident from fig.ESI 1 it is seen that all the precursors show the prominent peak between 270-280 nm. These peaks are due to the $n-\pi^*$ transition of OH, NH_2 , and Carboxylic acid (COOH) groups present on the surfaces of the molecules. Thus, there is no noticeable difference in UV-Visible spectra of synthesizing CDs and precursors.

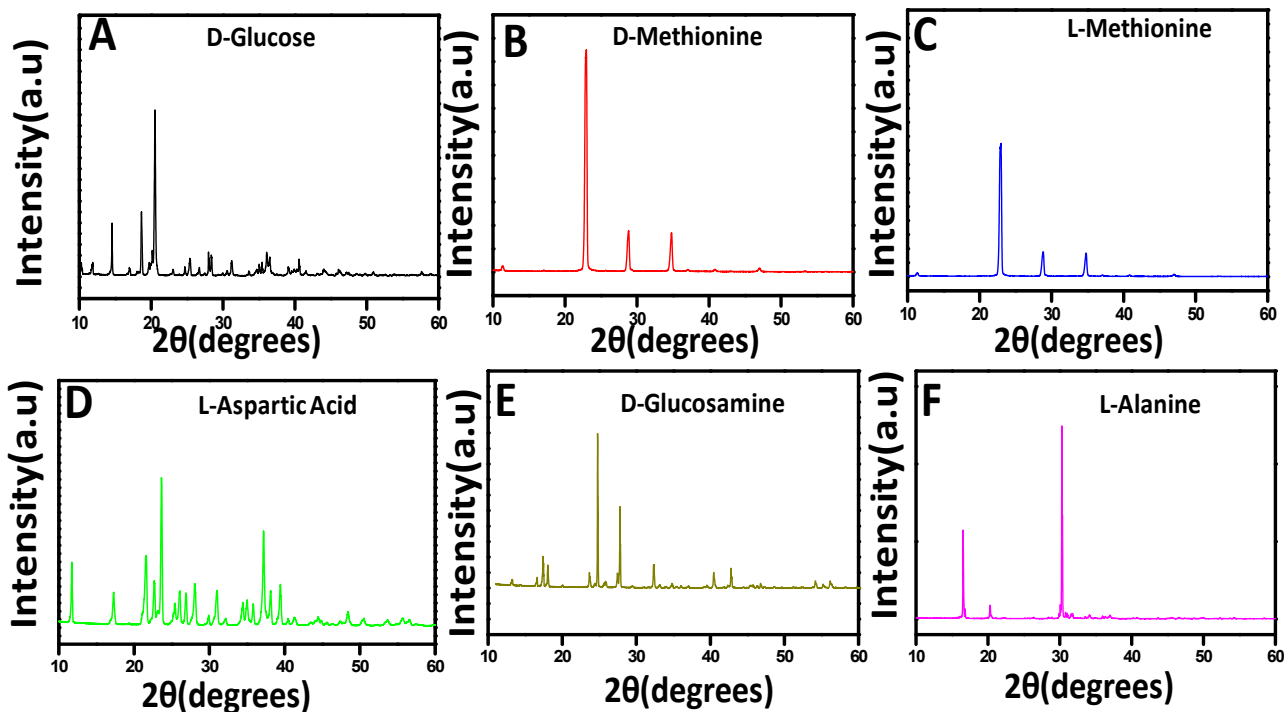


Fig. ESI2. Powder XRD spectra of A) D-Glucose, B) D-Methionine, C) L-Methionine, D) L-Aspartic Acid, E) D-Glucosamine and F) L-Alanine

We have also investigated the crystallinity precursor molecules using XRD analysis. From fig. ESI2, it is clear that all the molecules show intense and sharp peak in XRD which confirms the crystalline nature of all the precursor molecules. But this crystallinity is not retained after formation of carbon dots.

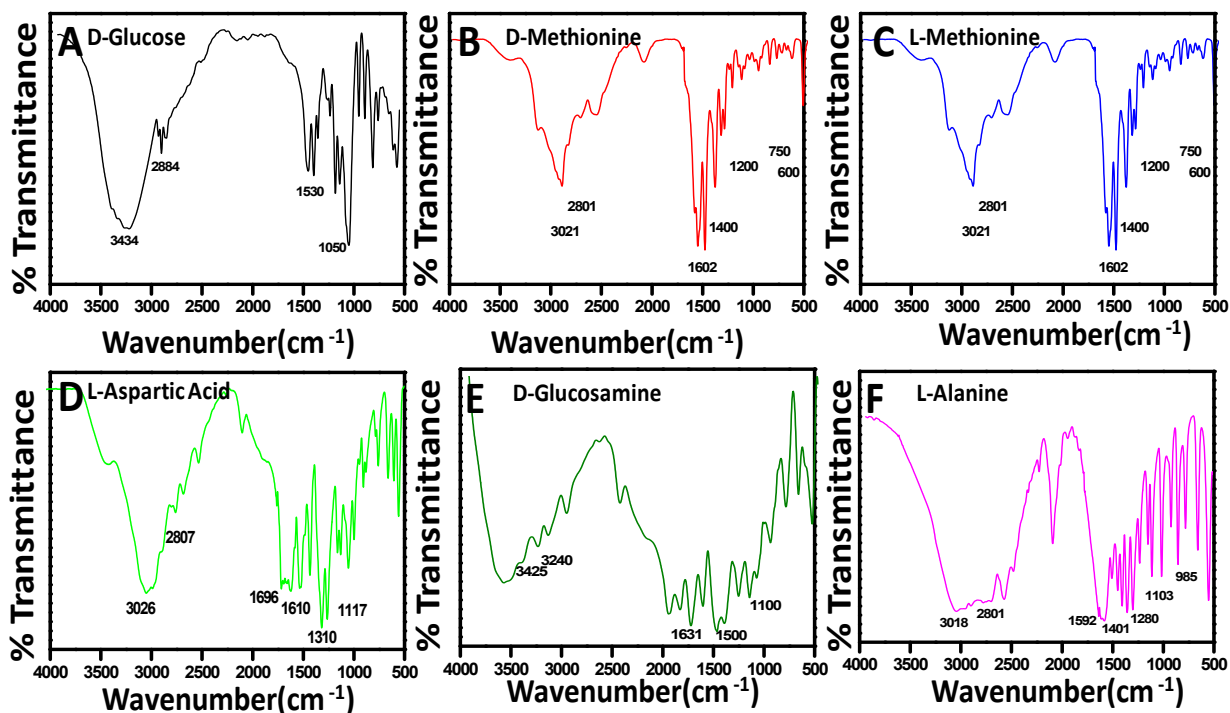


Fig.ESI3.FTIR spectra of A) D-Glucose, B) D-Methionine, C) L-Methionine, D)L-Aspartic Acid, E) D-Glucosamine and F) L-Alanine

Chemical structures of precursor molecules were also characterized with FT-IR and shown in fig.ESI3. The peaks for precursors molecules are sharp and more intense compared to CDs. It can be attributed to the restriction of the vibrations due to the formation of the carbon dots. However, the range in which the peaks are positioned remains the same. Thus the chemically the CDs and the precursor's molecules are same.

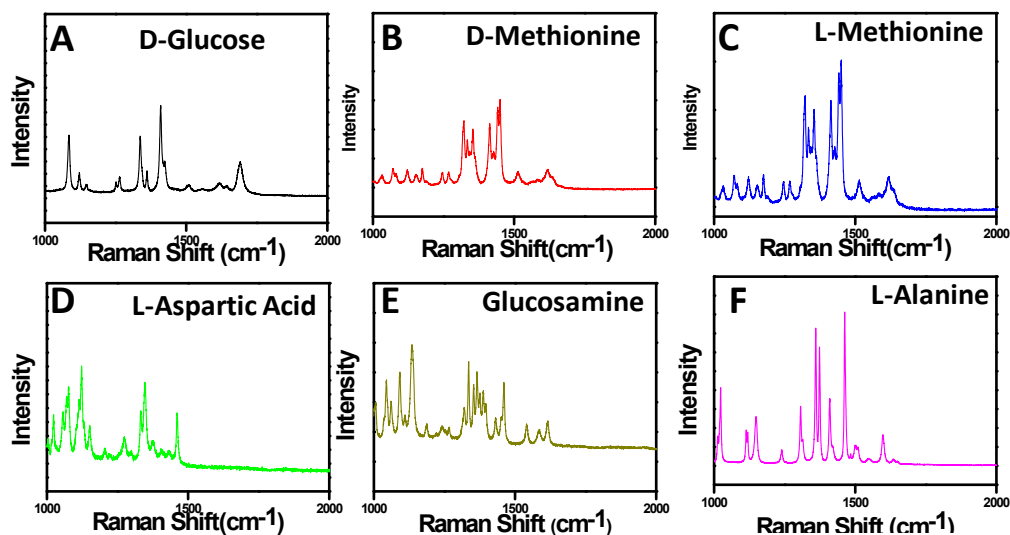


Fig. ESI4. Raman spectra of A) D-Glucose, B) D-Methionine, C) L-Methionine, D) L-Aspartic Acid, E) D-Glucosamine and F) L-Alanine

The Raman spectra for all the precursors are performed(1000-2000 cm^{-1}) and shown in fig.ESI4. The Raman spectra show that the characteristics peaks are appeared for the amino acids. We are unable to perform the Raman analysis of CDs, as the synthesis CDs are highly fluorescent, so it interferes in the Raman analysis.

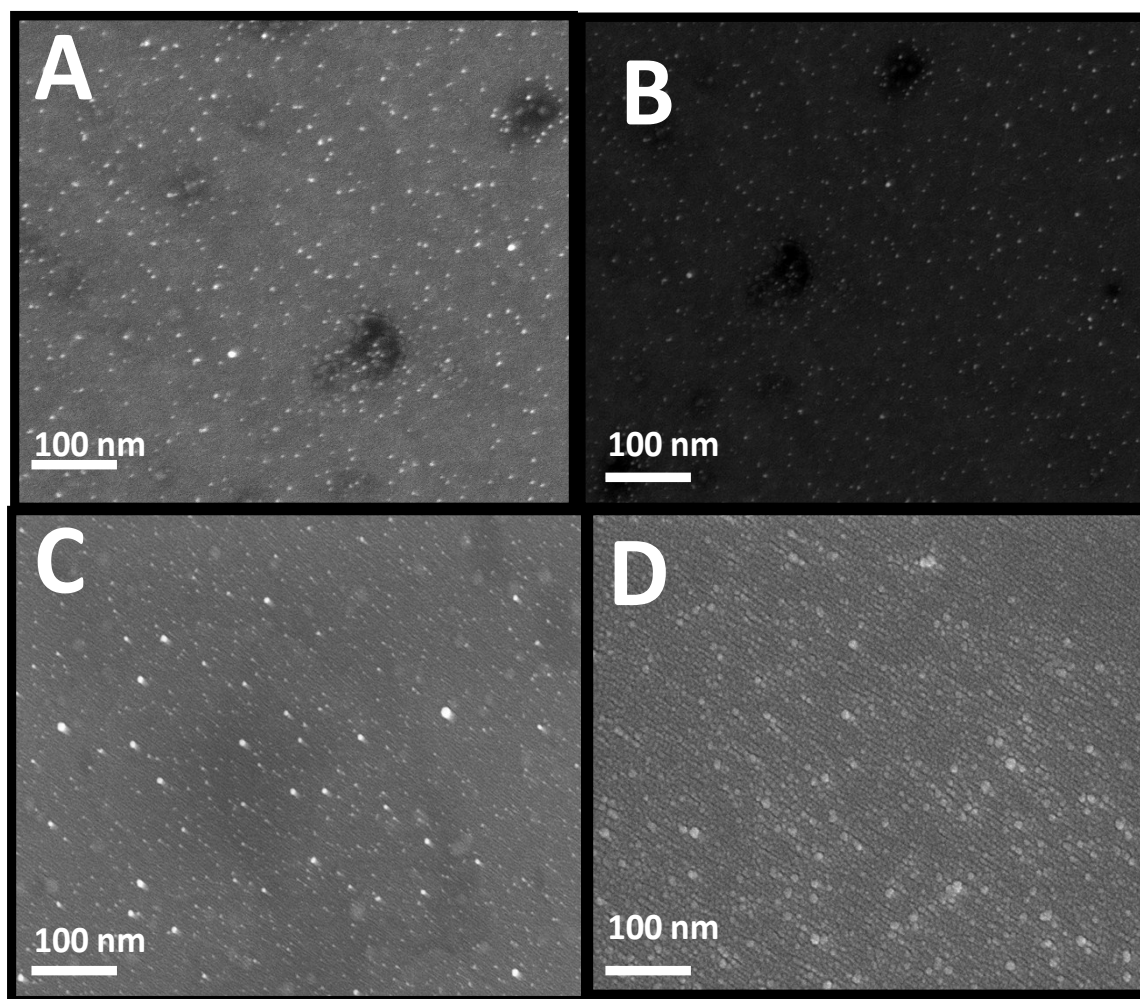


Fig. ESI5. Scanning Electron Microscope images of A) L-CD-Ala, B) L-CD-Asp, C)D-CD-Glc, D)D-CD-Glcamn.

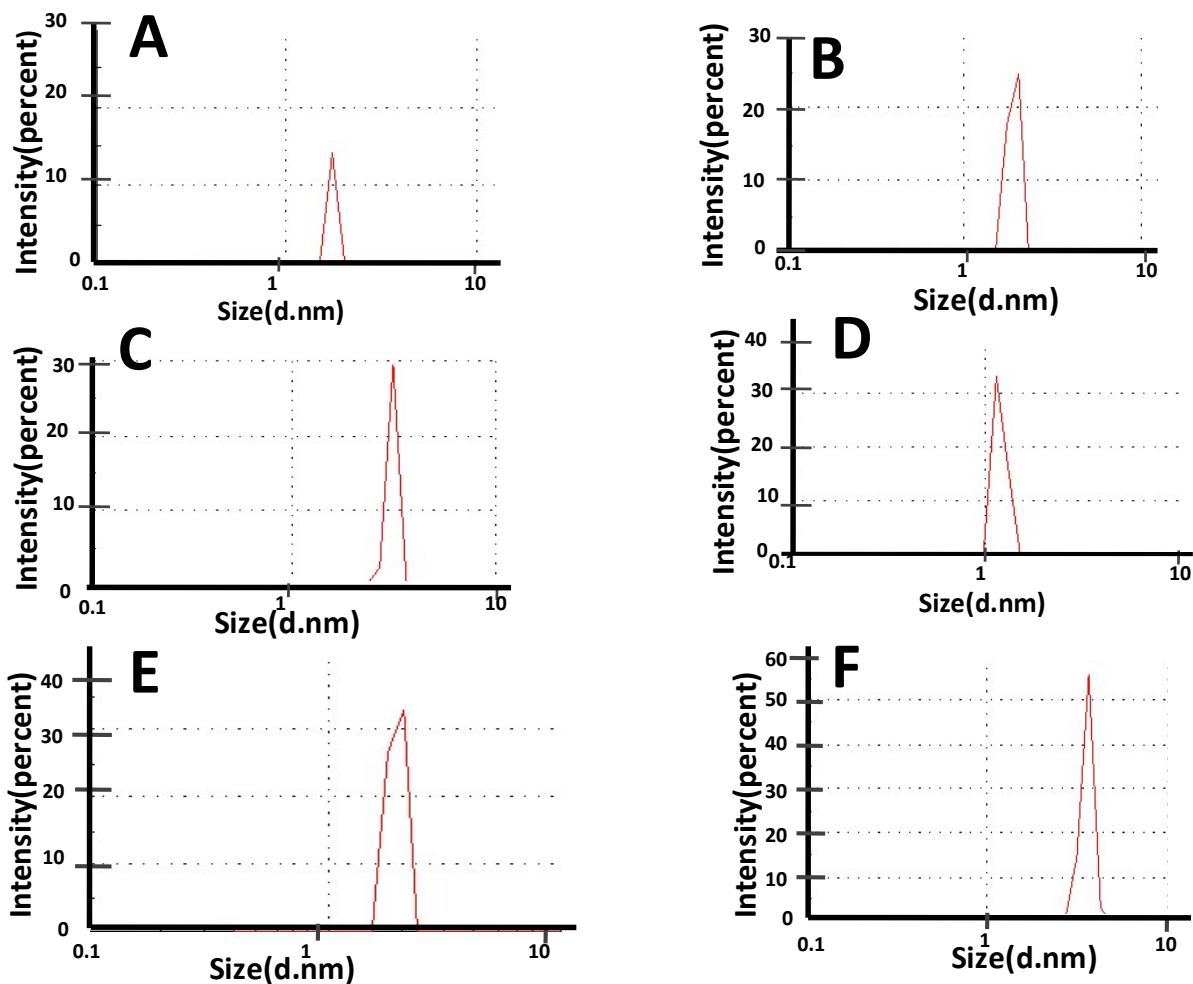


Fig. ESI6. DLS size of A) D-CD-Glc, B)D-CD-Meth, C)L-CD-Meth, D)L-CD-Asp, E)D-CD-Glc, F)L-CD-Ala.

The size of prepared chiral CDs is were measured by DLS instrument, and it is depicted in Fig. ESI6. From DLS it is confirmed that the average size of prepared CDs was below 10nm. We also performed Scanning electron microscopy characterization in figure ESI5 to study morphology and size of CDs. SEM microscopy images depicted that prepared chiral CDs were

size below 10 nm and it is uniformly distributed. This is indeed good agreement with the DLS size measurement.

Table ESI 7. Zeta potential values of D-CD-Glcamn, D-CD-Glc, L-CD-Asp, D-CD-Meth, L-CD-Meth E)L-CD-Ala.

Samples (CDs)	Zeta Potential(mV)
D-CD-Glcamn	-17.4
D-CD-Glc	-24.8
L-CD-Asp	-16.6
D-CD-Meth	-34.2
L-CD-Meth	-34.1
L-CD-Ala	-23.0

Table ESI 8. Specific rotation values of D and L- Carbon Dots

Samples (CDs)	Specific Rotation $[\alpha]_D$ (degree)
D-CD-Glcamn	+112
D-CD-Glc	+105
L-CD-Asp	-70
D-CD-Meth	+84
L-CD-Meth	-83

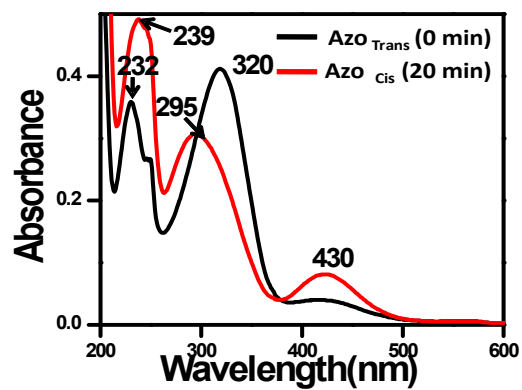


Fig. ESI 9. Uv-Visible Spectrum of Azo_{Trans} (0 min) and Azo_{Cis} (20 min)

Fig. ESI9 shows the Uv-visible spectra of trans and cis azobenzene. The bare azobenzene dispersion shows characteristics peaks at 232, 320 and 430 nm. The strong peaks at 232 and 320 nm are originated from $\pi-\pi^*$ transition and the weak peak at 430 nm is due to $n-\pi^*$ transition. It is well known that before Uv irradiation the trans form of azobenzene is more dominant and stable. After Uv irradiation (365nm) of azobenzene for 20 min the 320 nm peak is reduced and shifted to 239nm,295 nm respectively and the 430 peak becomes more prominent, and cis isomer becomes more stable. Thus from a UV-visible study, it is confirmed that trans azobenzene is successfully transformed to cis isomer (20min Uv Irradiated,365 nm).

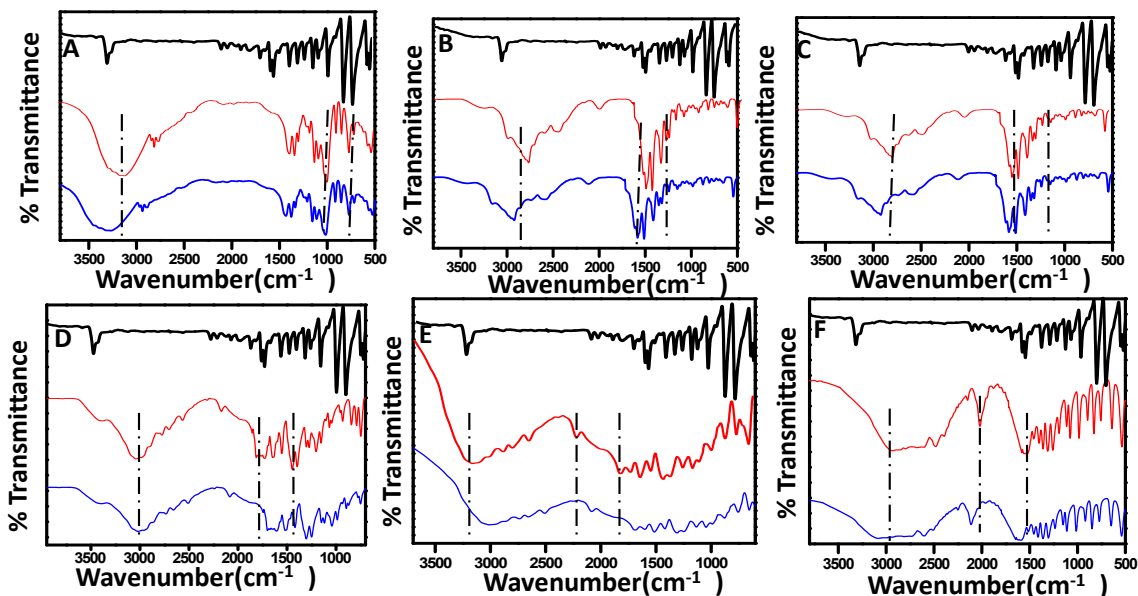


Fig.ESI10 FT-IR spectra of A)Azobenzene, D-CD-Glc and azobenzene/ D-CD-Glc(20 mins,Uv) B) Azobenzene, D-CD-Meth and azobenzene/ D-CD-Meth(20 mins UV), C) Azobenzene, L-CD-Meth and azobenzene/ L-CD-Meth(20 mins Uv), D) Azobenzene, L-CD-Asp and azobenzene/ L-CD-Asp(20 mins,Uv) E) Azobenzene, D-CD-Glcmn and azobenzene/ D-CD-Glcmn(20 mins,Uv) and F) Azobenzene, L-CD-Ala and azobenzene/ L-CD-Ala(20 mins,Uv). (Black line-Azobenzene, red line-Chiral CDs and blue line-Azobenzene/chiral CDs,20 mins Uv treated).

The evidence for noncovalent interaction is formed FT-IR spectroscopy characterization of Azobenzene, Chiral CDs, and Azobenzene/Chiral CDs(20mins, Uv). The spectra are depicted in fig. ESI10 where black, red and blue line denotes the azobenzene, Chiral CDs and Azobenzene/Chiral CDs respectively. For azobenzene molecules, the N=N stretching vibration occurs at 1581cm^{-1} , and it is coupled with the phenyl C=C stretching. The peak at 1297cm^{-1} is due to the C-N stretching, and the peak at 3160cm^{-1} can be attributed to the alkene C-H stretching. Peaks for aromatic C-H bending is from 2000 to 1500cm^{-1} . The detailed chemical structure of L-CD-Ala, L-CD-Meth, D-CD-Meth, D-CD-Glc, D-CD-Glcamn, and L-CD-Asp are already discussed in the FTIR section in the main paper. From fig. ESI6, it is observed that the main characteristic peaks of the chiral CDs are only shifted after interaction with azobenzene(20 mins Uv). There does not appear any new peaks in the spectra which indirectly proves that there is only noncovalent interaction between azobenzene and CDs.

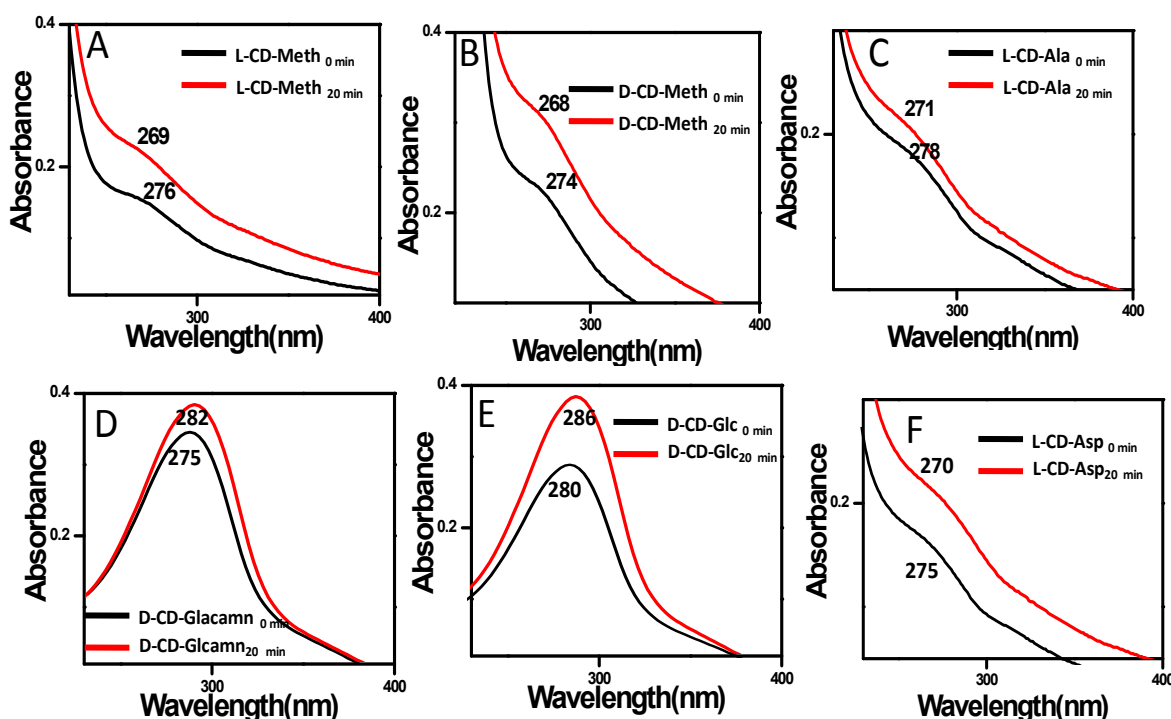


Fig. ESI 11. Uv-Visible Spectrum of (A) L-CD-Meth_{0min}, L-CD-Meth_{20 min} (B) D-CD-Meth_{0min}, D-CD-Meth_{20 min} and (C) L-CD-Ala_{0 min}, L-CD-Ala_{20 min} (D)D-CD-Glcaman_{0 min}, D-CD-Glcaman_{20 min},(E) D-CD-Glc_{0 min}, D-CD-Glc_{20 min}, (F)) L-CD-Asp_{0min}, L-CD-Asp_{20 min}

UV response of chiral CDs for same irradiation time (20 min,365nm) is also investigated, and it is observed that there is a slight shift in Uv peaks for both D and L-CDs and it is depicted in

Fig. ESI11. We have also characterized the synthesized chiral CDs with and without irradiation in Uv (20 min, 365 nm). From fig. ESI 7 it is observed that after Uv irradiation the characteristic peaks of Uv are shifted. For L-CD-Meth the peak at 276 nm ($n-\pi^*$ transition) is shifted to 269 nm, and for D-CD-Meth the prominent 274 nm ($n-\pi^*$ transition) peak is shifted to 268 nm. Again for L-CD-Ala, the 278 nm peak is observed at 271 nm after Uv radiation, and 275 nm peak of D-CD-Glc appears at 282 nm. The Uv peak of D-CD-Glc is at 280 nm and shifted to 286 nm and for 275 nm peak of L-CD-Asp observed at 270 nm after irradiation.