Iceland Liechtenstein Norway grants
"Working together for a green, competitive and inclusive Europe"

GREENCAM for tomorrow

UNIVERSITY OF BUCHAREST

NTNU
Norwegian University of Science and Technology

UNIVERSITATEA DIN BUCUREȘTI
VIRTUTE ET SAPIENTIA

THIRD REPORT:

From humin wastes to Carbon Quantum Dots (CQDs) based Photocatalytic nanocomposites

MSc. Student:
Guzo Nicolae-Cristian

Coordinator:
Prof. Dr. Simona M. Coman

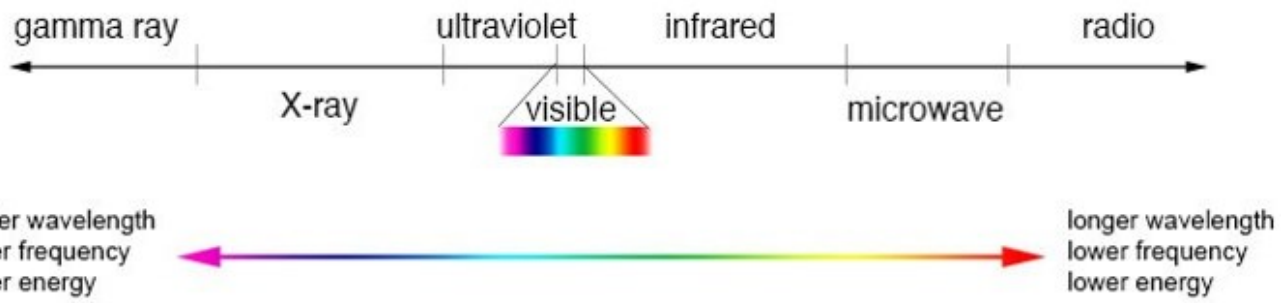
Master:
Chemistry of Advanced Materials

June 2021

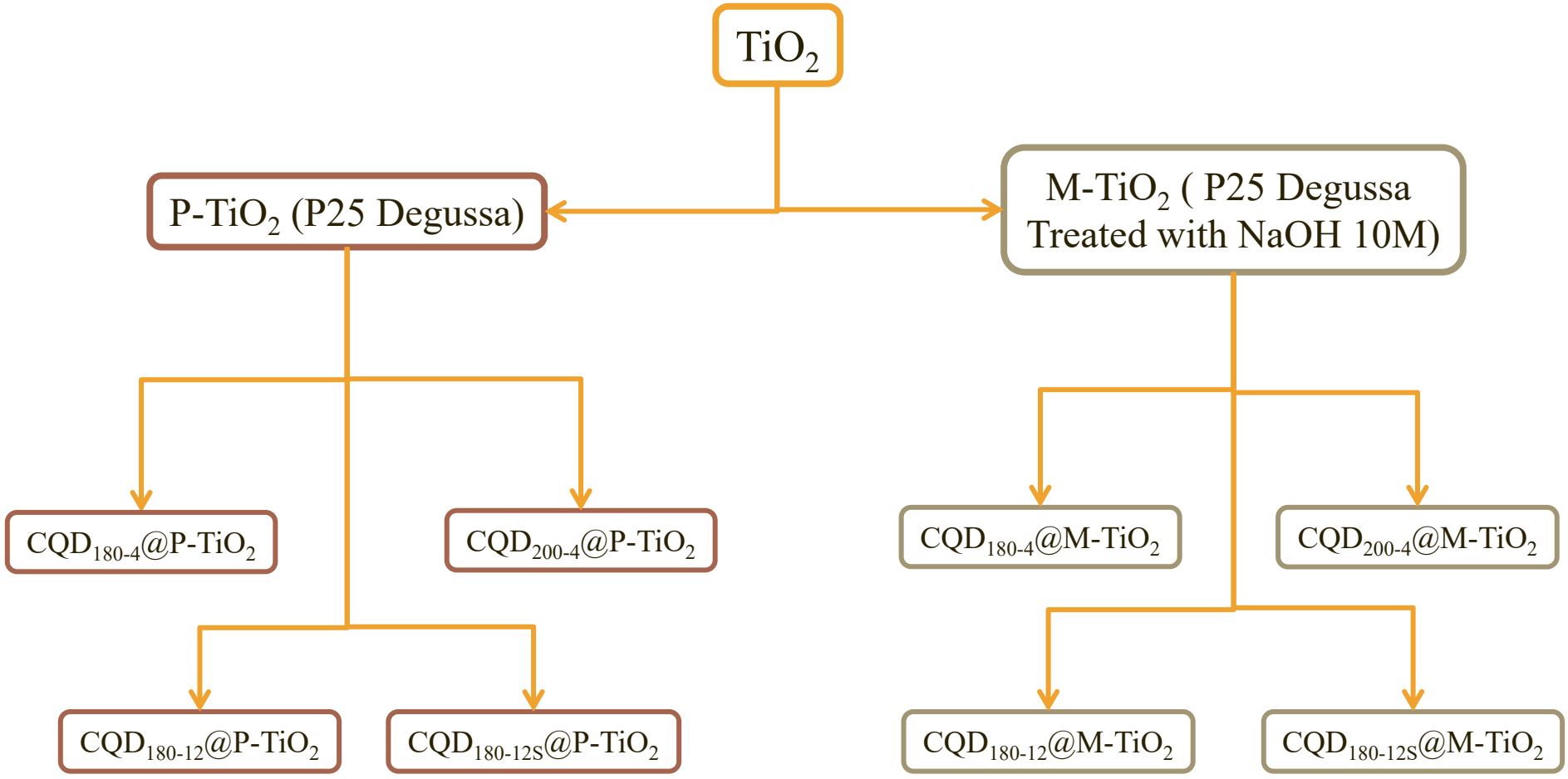
Disclaimer: This was realised with the EEA Financial Mechanism 2014-2021 financial support. Its content (text, photos, videos) does not reflect the official opinion of the Programme Operator, the National Contact Point and the Financial Mechanism Office. Responsibility for the information and views expressed therein lies entirely with the author(s).

INTRODUCTION

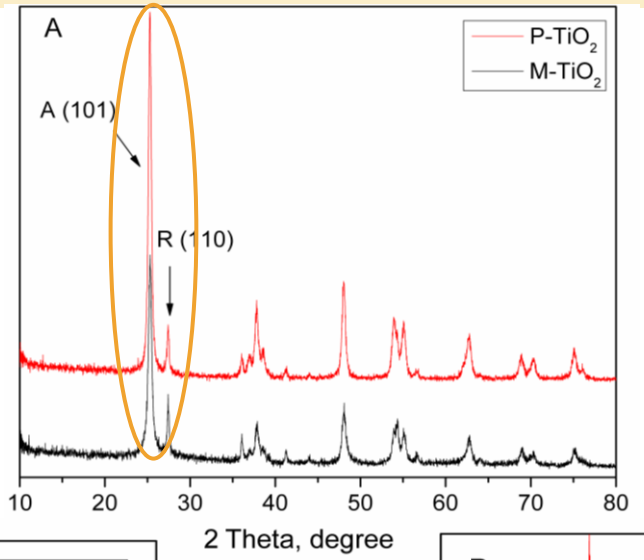
- Problems with the TiO_2 in photocatalysis.
- How can Carbon Quantum Dots (CQDs) help?
- Why TiO_2?
- What to expect?

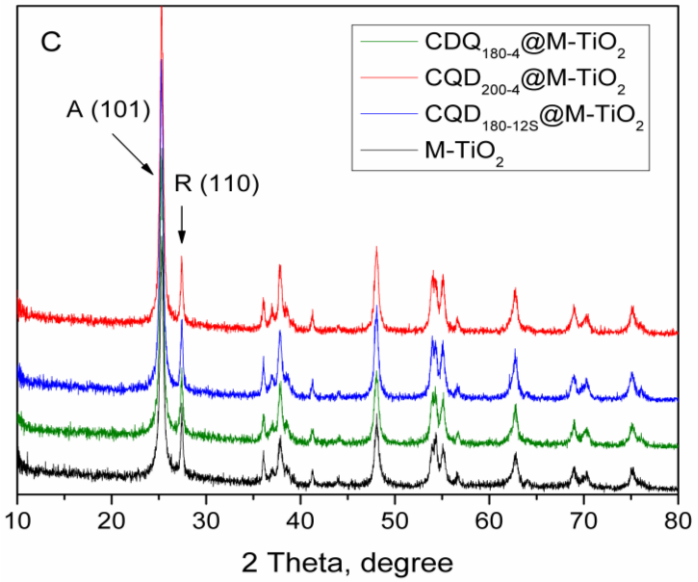


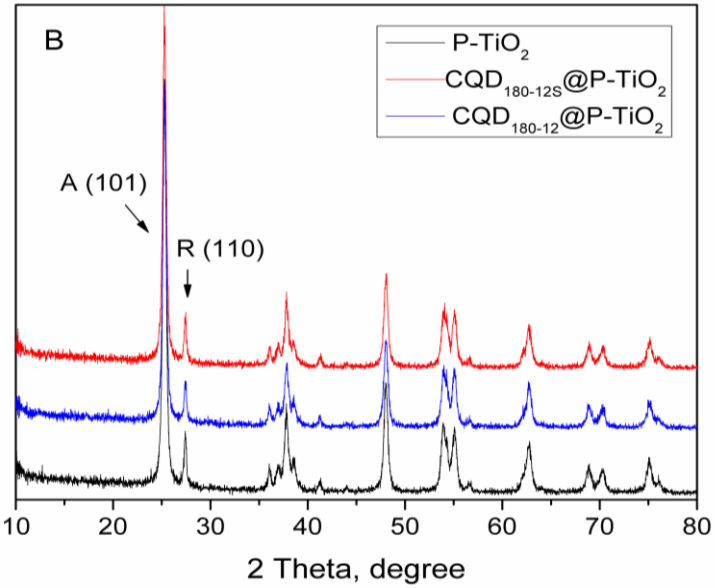
SYNTHESIS OF NANOCOMPOSITES



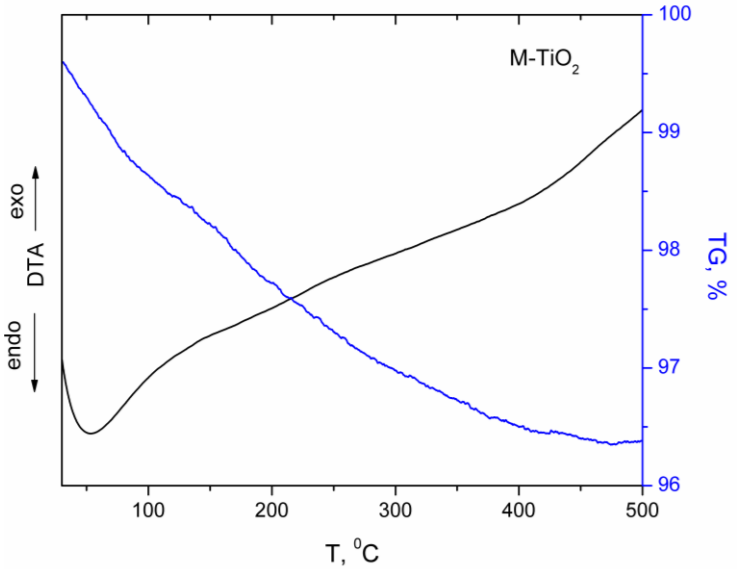
X-RAY DIFFRACTION

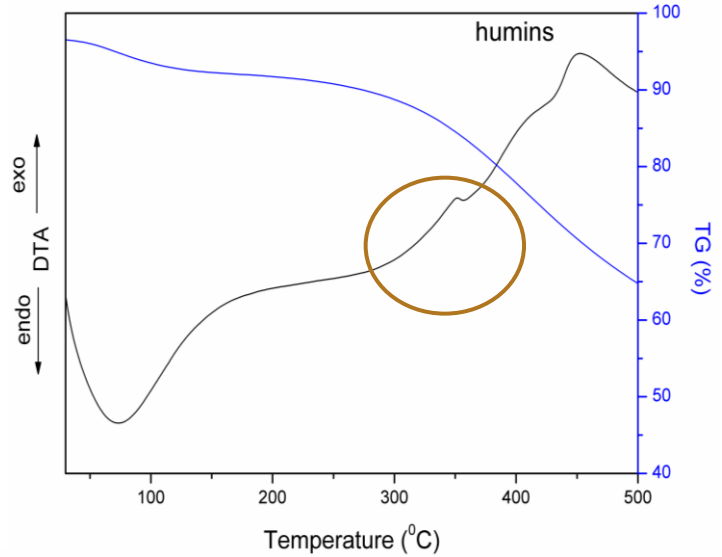


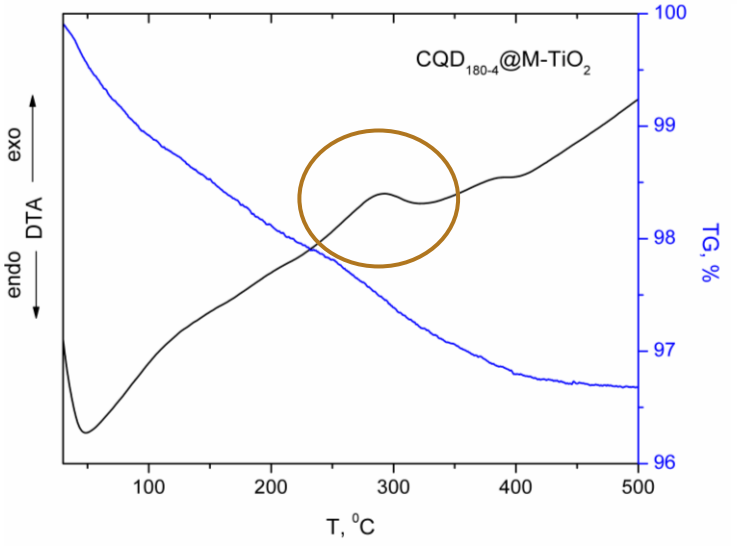


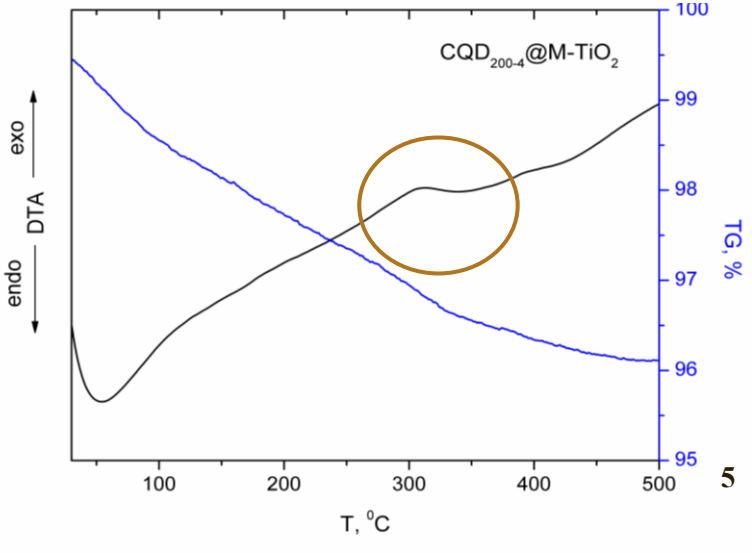


TG/DTA

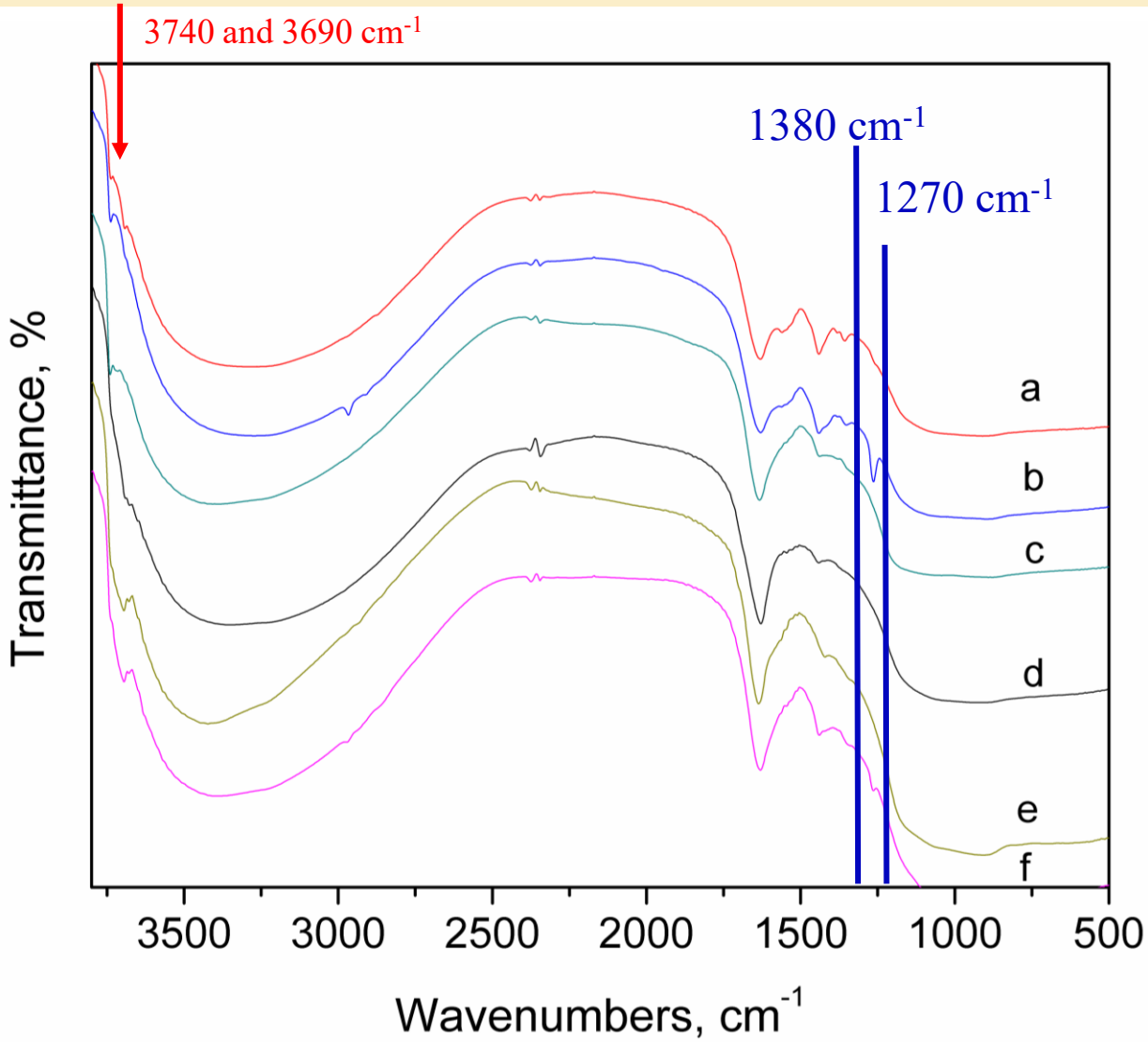

M-TiO2
exo
DTA
endo
TG, %
T, °C


humins
exo
DTA
endo
TG (%)
Temperature (°C)


CQD180-4@M-TiO2
exo
DTA
endo
TG, %
T, °C


CQD200-4@M-TiO2
exo
DTA
endo
TG, %
T, °C

IR SPECTROSCOPY



a – $CQD_{180\text{-}12S}$@M-TiO_2

b – $CQD_{200\text{-}4}$@M-TiO_2

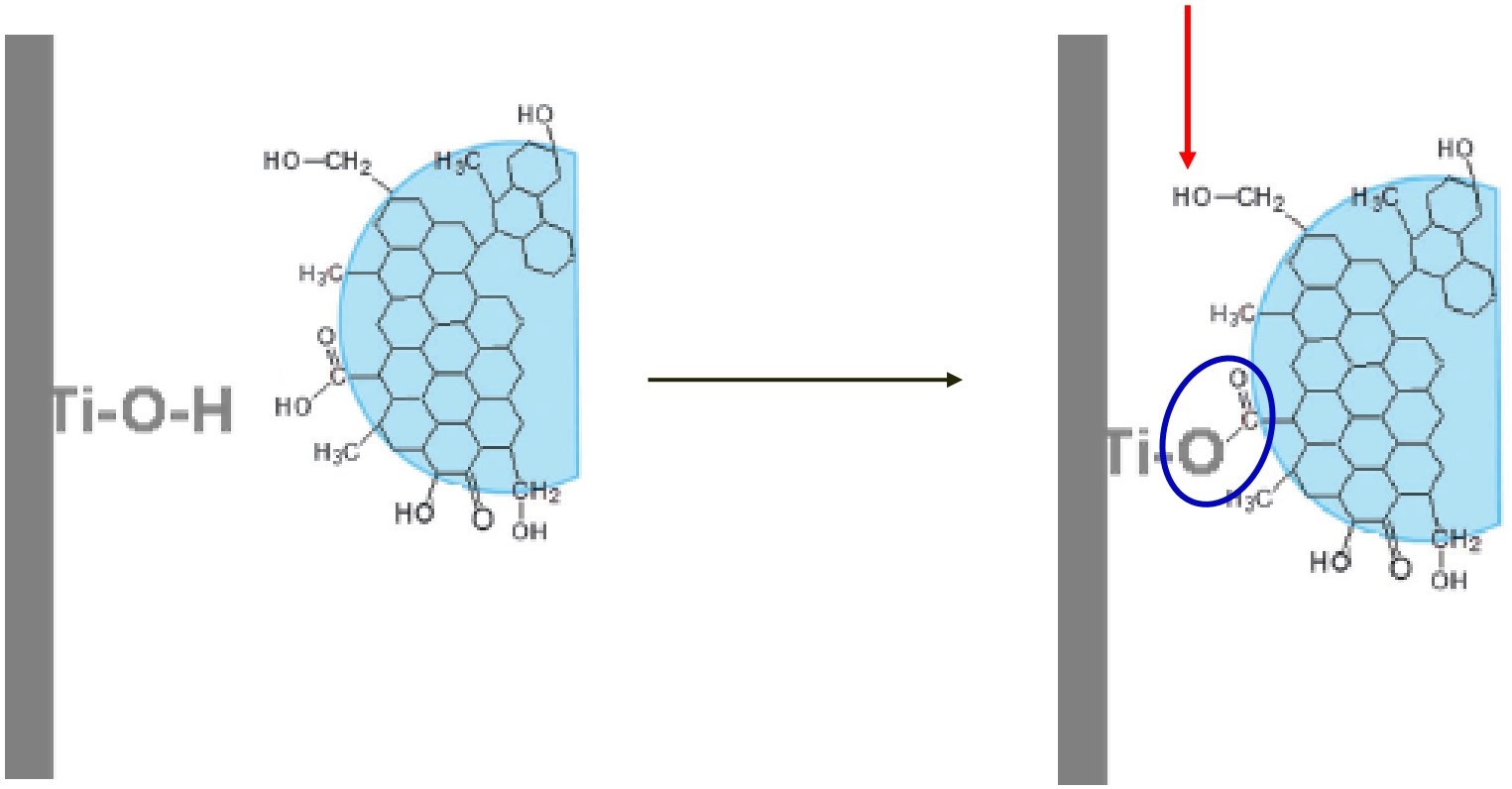
c – $CQD_{180\text{-}4}$@M-TiO_2

d – M-TiO2

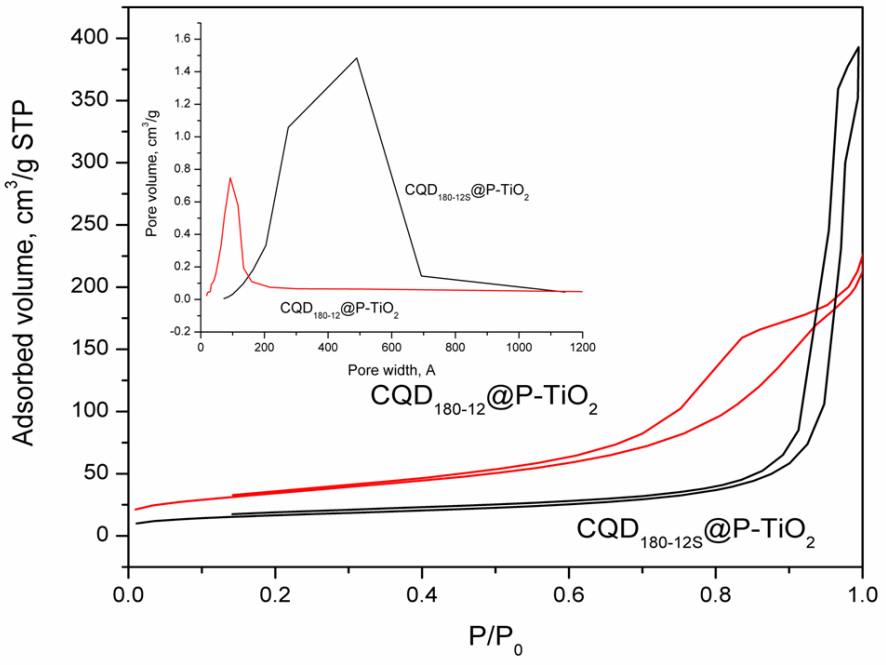
e – $CQD_{180\text{-}12}$@M-TiO_2

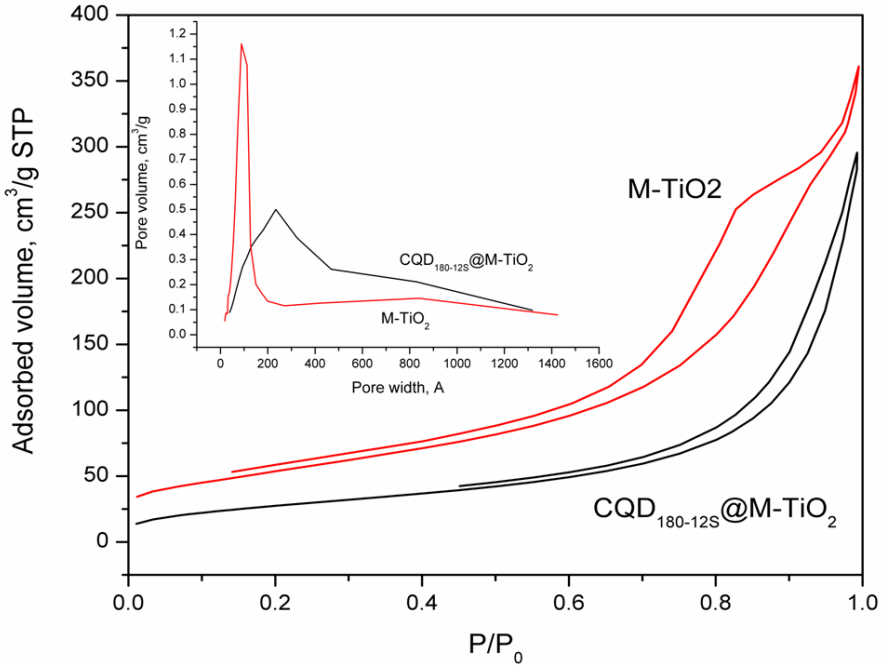
f – $CQD_{180\text{-}12S}$@P-TiO_2

IR SPECTROSCOPY



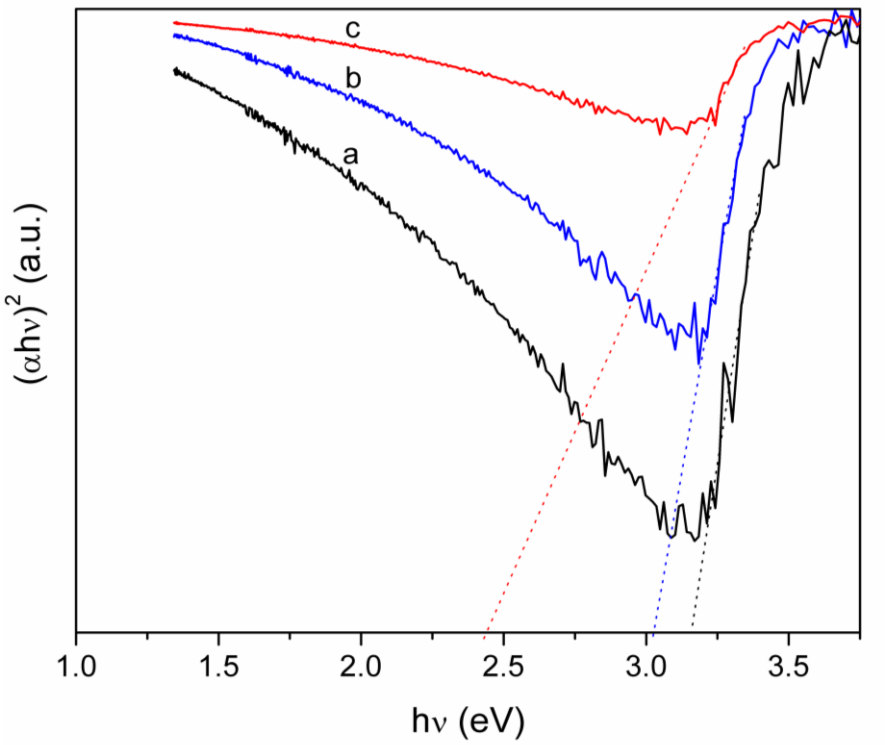
ADSORPTION-DESORPTION ISOTHERMS OF LIQUID N_2



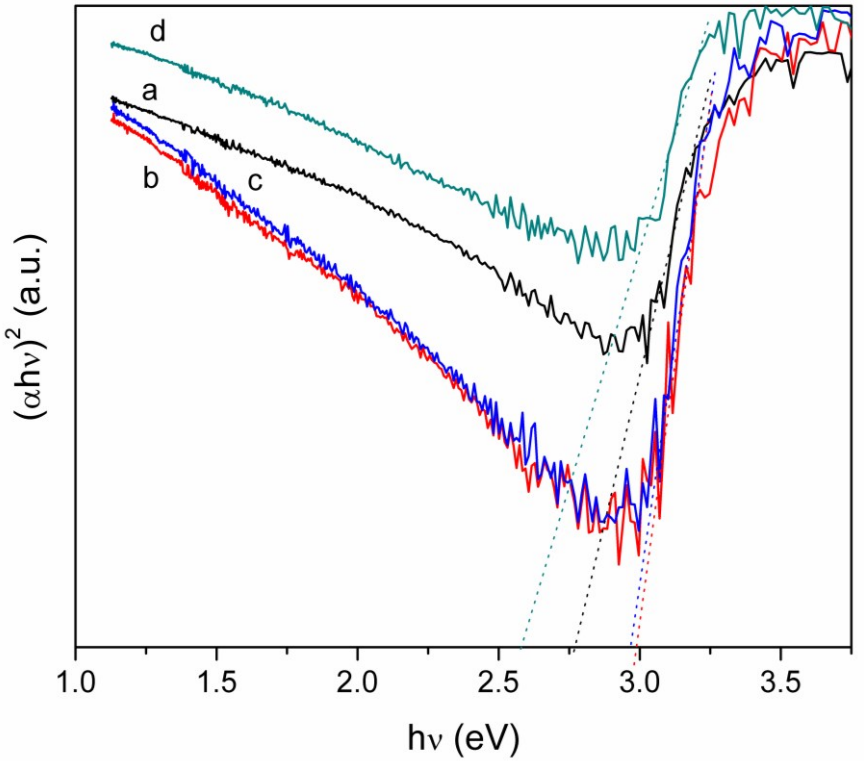


Entry	Sample	S_{BET}, m^2/g	V_p, cm^3/g	D_p, nm
1	P-TiO_2	54	0.31	19.7
2	$CQD_{180\text{-}12}$@P-TiO_2	123	0.33	8.7
3	$CQD_{180\text{-}12S}$@P-TiO_2	59	0.54	27.1 and 49.0
4	M-TiO_2	194	0.56	9.1
5	$CQD_{180\text{-}12S}$@M-TiO_2	203	0.45	23.3

BANDGAP COMPARISON

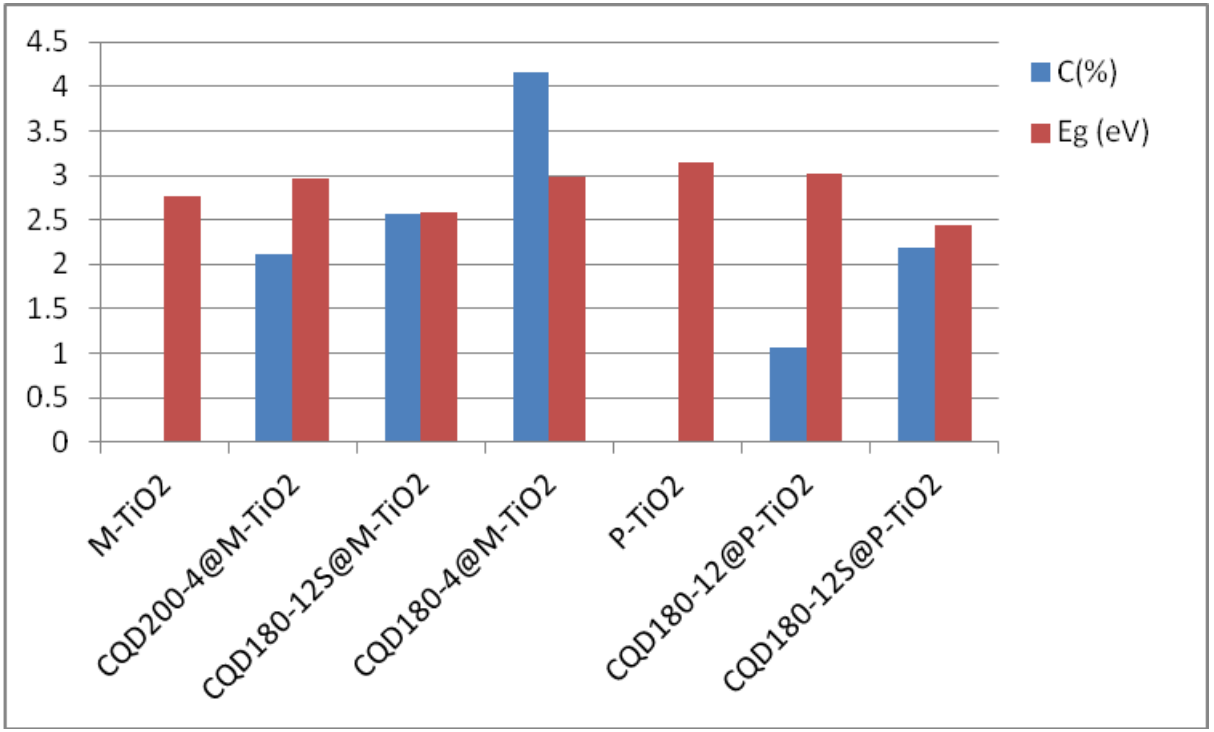


a – P-TiO_2
b – $CQD_{180\text{-}12}$@P-TiO_2
c – $CQD_{180\text{-}12S}$@P-TiO_2



a – M-TiO_2
b – $CQD_{180\text{-}4}$@M-TiO_2
c – $CQD_{200\text{-}4}$@M-TiO_2
d – $CQD_{180\text{-}12S}$@M-TiO_2

BANDGAP CORRELATION WITH CQDS



Sample	$CQD_{180\text{-}4}$ @M-TiO_2	$CQD_{180\text{-}12S}$ @M-TiO_2	$CQD_{200\text{-}4}$ @M-TiO_2	$CQD_{180\text{-}12S}$ @P-TiO_2	$CQD_{180\text{-}12}$ @P-TiO_2
C (%)	4.162	2.564	2.111	2.188	1.065
H (%)	1.329	0.878	1.127	0.638	0.334

CONCLUSIONS

- The applied synthesis methodology for the M-TiO_2 sample lead to a mixed-phase TiO2 junctions between spherical-like particles of anatase, rutile and anatase nanotubes.

- Generated high surface and defects (oxygen vacancy) in synthesized M-TiO_2 may play an important role in enhancing the photoactivity of heterophase conjunctions.

- Coupling CQDs with TiO_2, the CQDs anchored on the surface of TiO_2 increases its surface roughness, resulting in the formation of a second heterointerface between CQDs and TiO_2 carrier.

Thank You!