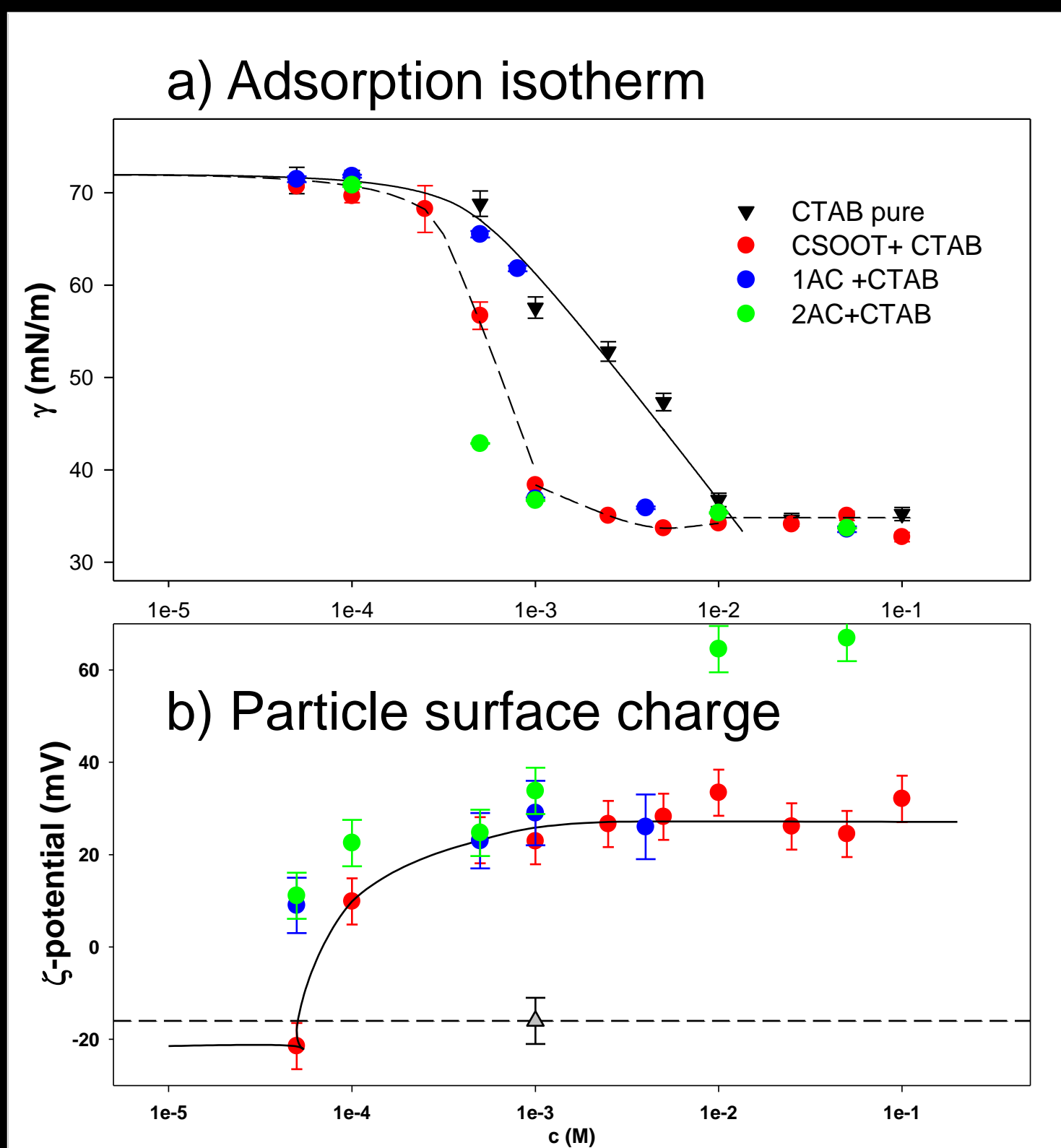




The study faces the problem of porous materials tailoring, produced by solidification of liquid foams stabilized by nano sized solids coming from different origins. Furthermore, it leads to better understanding of the relation between the interfacial properties of mixed colloidal systems, containing Activated Carbon (AC) nanoparticles at different degree of hydrophobicity, surfactants and the stability of the corresponding systems such as liquid and solid foams, or emulsions [1, 2].

The interfacial properties of the single particle-laden interfacial layer are characterized by dynamic interfacial tension, interfacial rheology and hydrodynamics measurements together with stability of the corresponding particle stabilized foams. Due to this material design can actually start on the level of single liquid-air (bubble) or liquid-liquid (drop) interface [2,3]. Such particle stabilized wet foams are used as templates for the gel-casting process, when polymerization occurs between organic Poly(vinyl alcohol) and cross-linker DHF, previously dissolved in the liquid phase, providing a solid foam structure (**green body**) with particles mainly distributed at the surface of the cells as shown in Fig.2. A further thermal treatment at high temperature (500-1500°C) allows the complete removal of organic components and the proper sintering of these porous materials. The porous materials obtained from these systems, according to specially developed procedure [4,5] are then characterize from the morphological and textural point of view [4], via SEM analysis (Fig.2 and Fig.3) and by nitrogen adsorption isotherms (BET) (Fig.4), and CO₂/N₂ selectivity and CO₂ adsorption (Fig.5).

1. Particle – Surfactant composition



- Significant decreases in value of **surface tension** for particle-CTAB dispersions.
- Particle – CTAB complex formation
- Effect visible for dispersion in certain composition: 0,1wt% of Carbon and 5e-4M, 1e-3M of CTAB; and 0,1wt% of TiO₂ and 1e-4M of CTAB
- Particle surface **charge neutralization** surfactant modified particles assume amphiphilic character (TiO₂ -50eV, Carbon - 16eV)
- Charge inversion phenomena**
- Formation of a second layer of surfactant onto carbon surface

2. From wet foam to green body

- In CMC particles becomes hydrophobic again due to the double layer formation-stability not improved
- Foams stability improved by the presence of particles 2AC/1AC/TiO₂ at C_{CTAB} = 5e-4M/ 1e-3M/ 1e-4M.
- The great improvement of stability reached for foams with increased concentration of particle-CTAB complexes
- Stability of the obtained wet foams is correlated with the properties of the final porous material
- Studied liquid foams combined with polyvinyl alcohol (PVA) and highly biocompatible 2,5-dimethoxy-2,5-dihydrofuran (DHF)

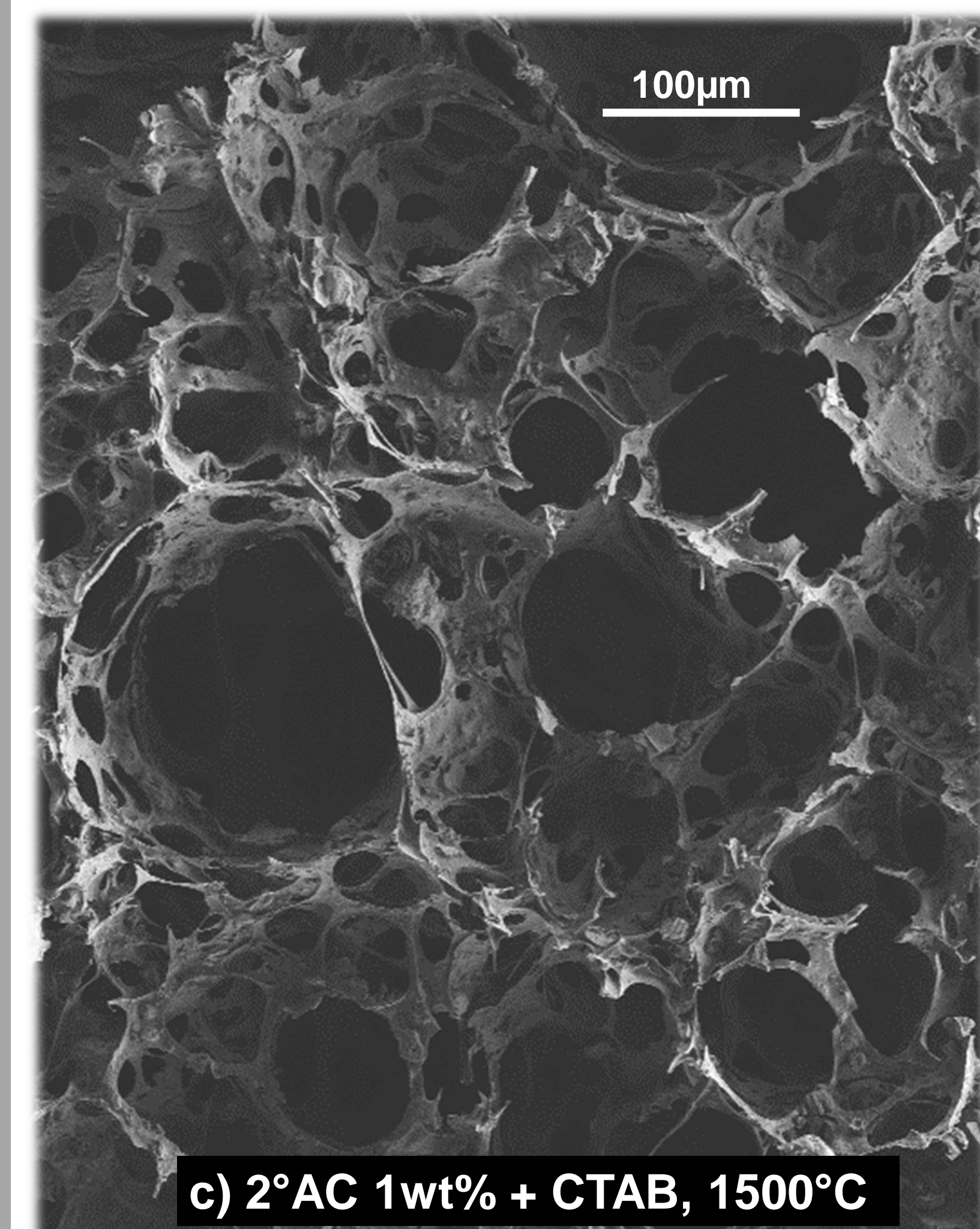
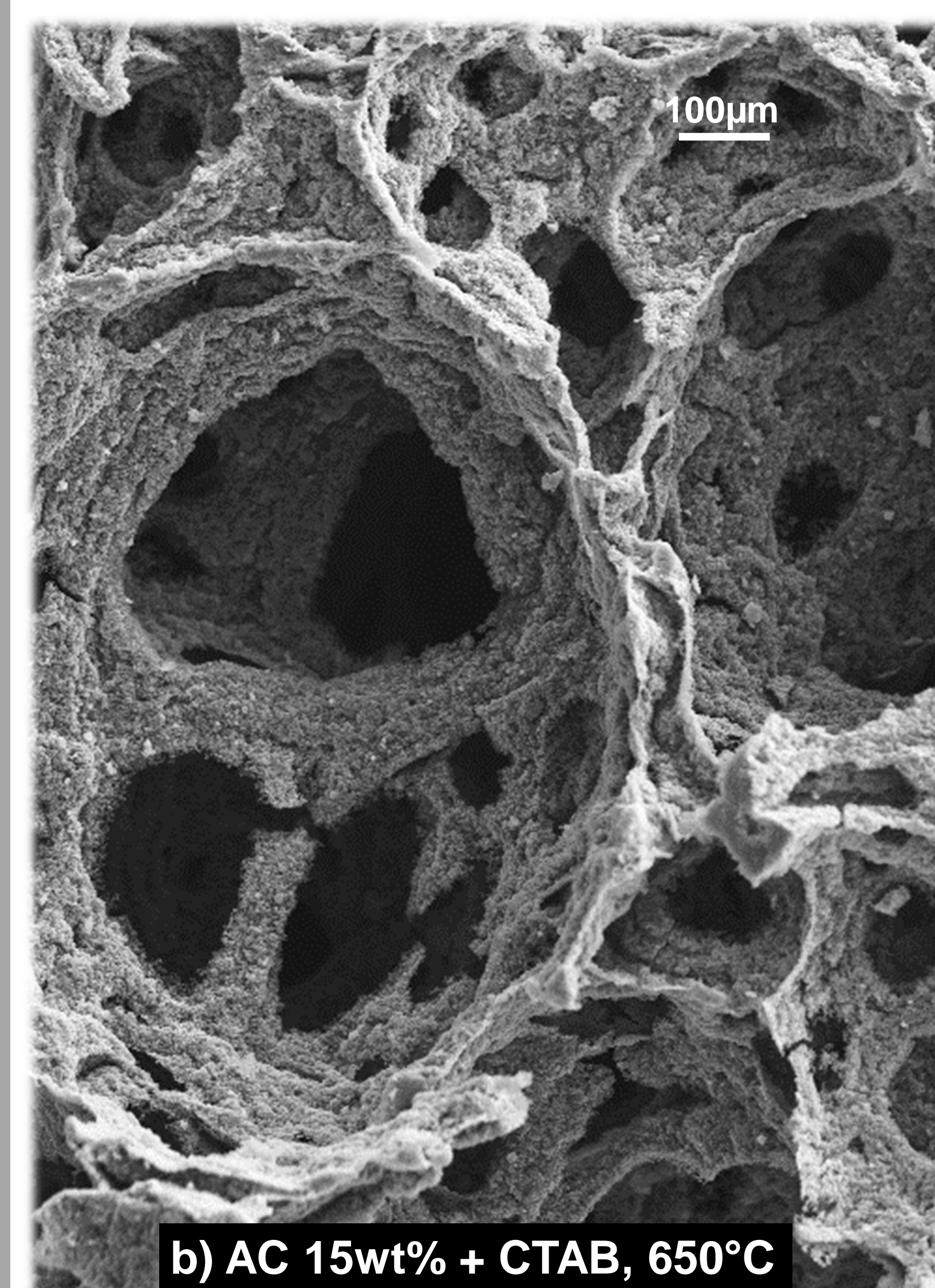
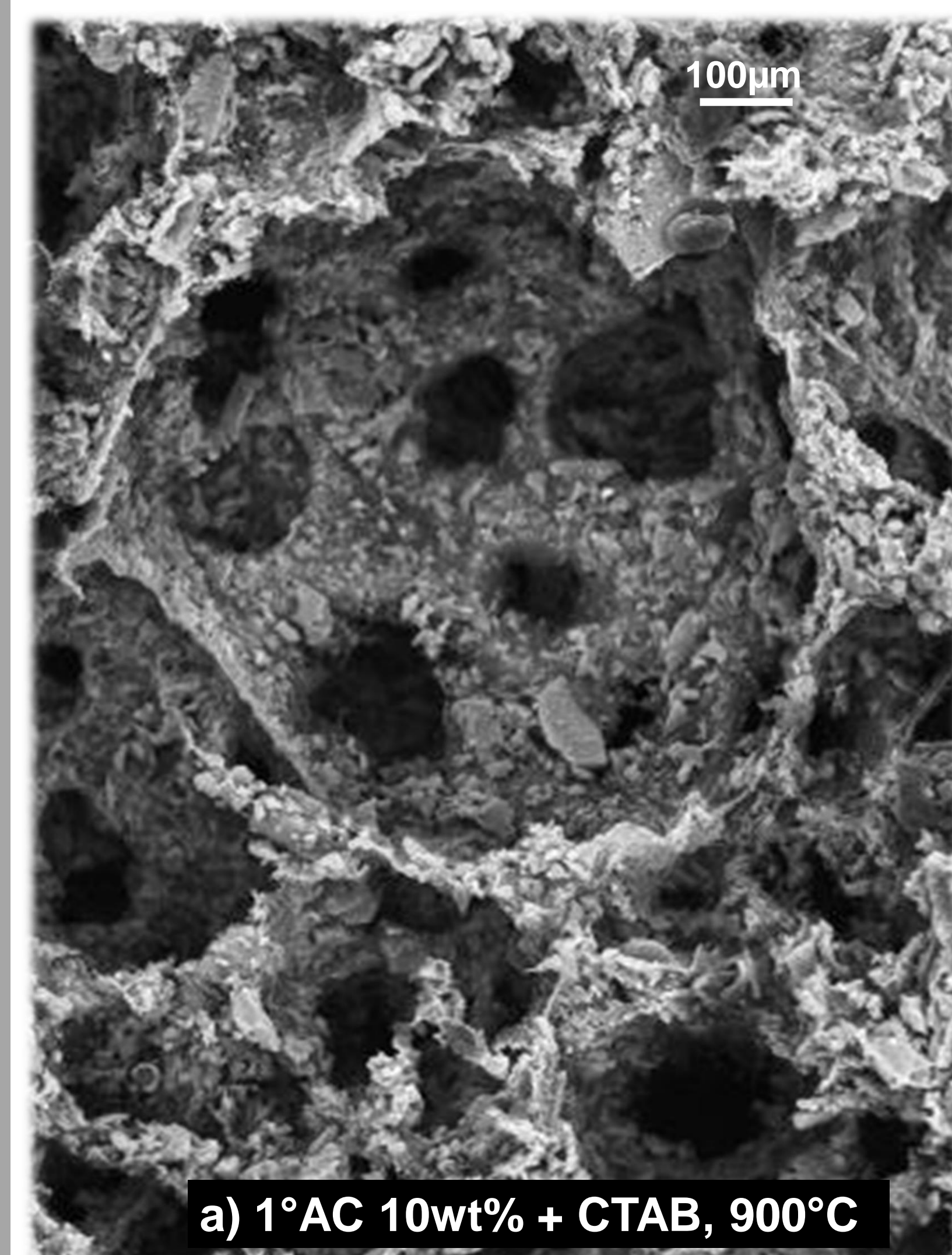


Figure 5 – Morphology of thermally treated particle laden solid foams: (a) 1°AC 10wt% + CTAB, at 900°C; (b) TiO₂ 15wt% + CTAB, at 650°C; (c) 2°AC 1wt% + CTAB, at 1500°C.

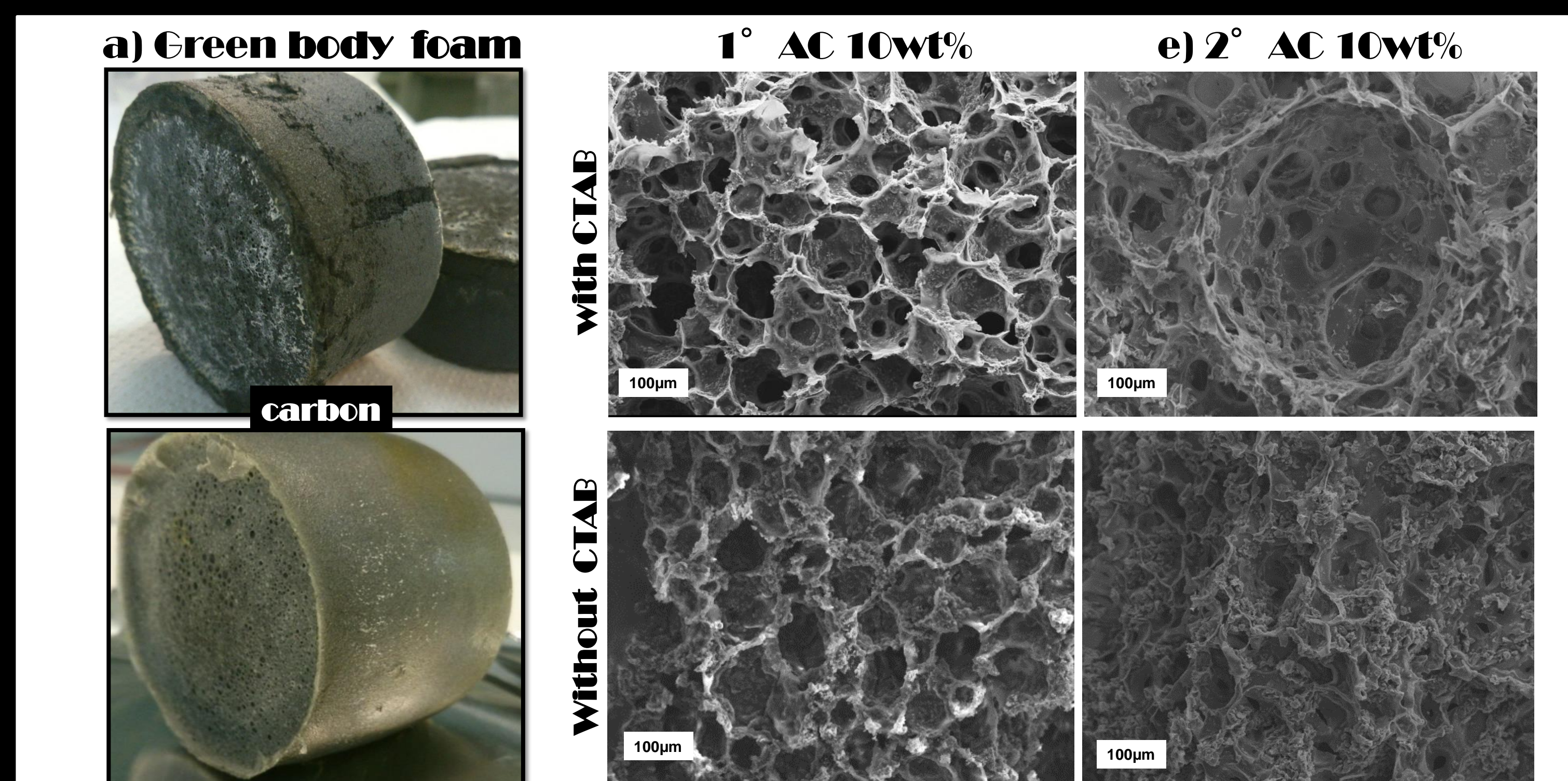


Figure 2 - Green body foam of Carbon (a) and green body foam microstructure of 1wt% (b) and 10wt% (c) Activated Carbon foam with and without a CTAB surfactant obtained through gel casting process, at 80°C.

3. High temperature treatment

- Foam cells became bigger after the organics removal. Volume shrinkage observed
- No gas adsorption for **green body foam**
- Increasing the treating temperature up to 900°C favors the ability to adsorb N₂
- The obtained material architectures display hierarchical and high porosity, with open-cell interconnected macroporosity

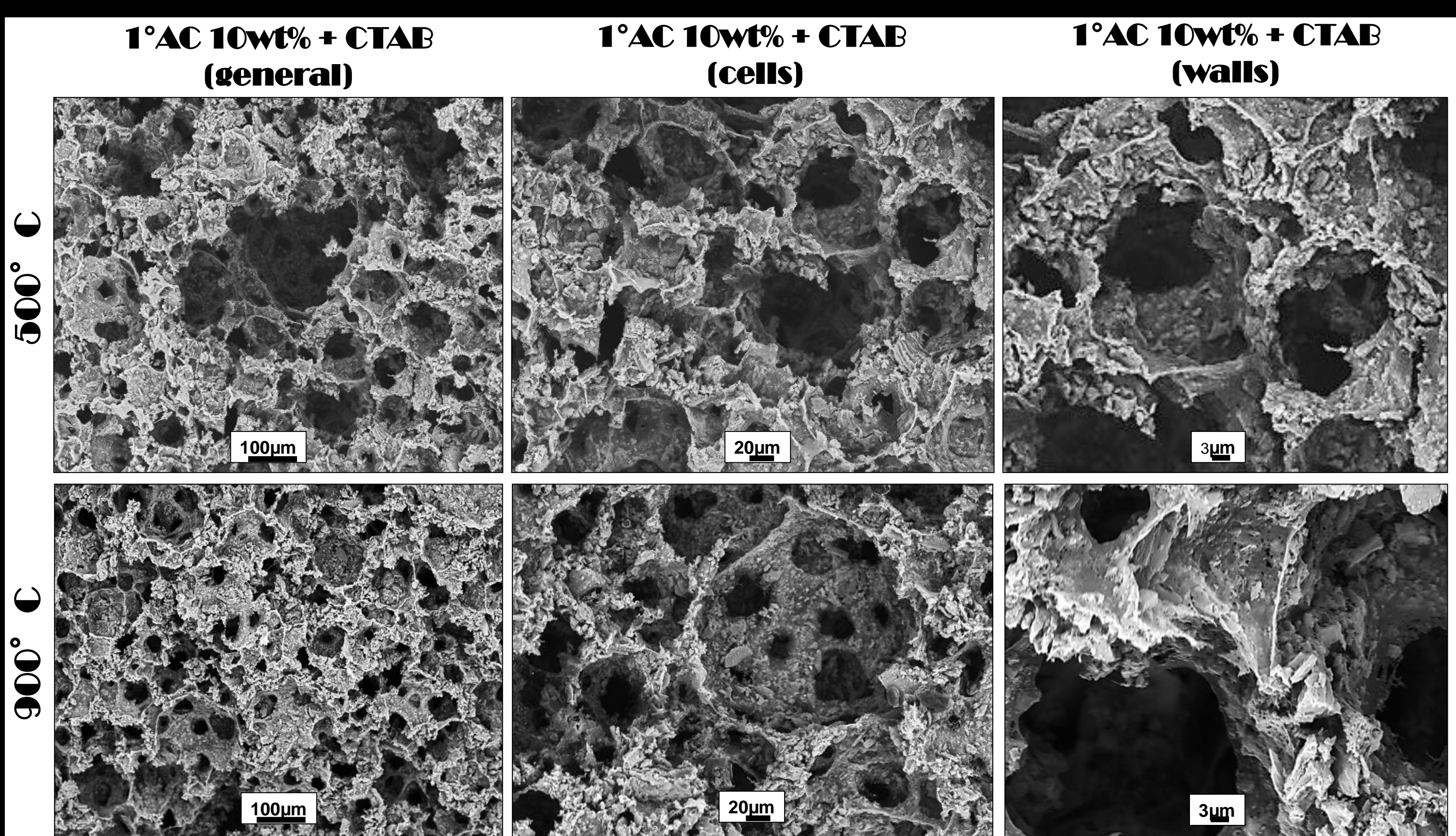


Figure 3 – Solid foams of 1AC 10wt%+CTAB after thermal treatment at 500°C and 900°C. SEM micrographs of the general foam morphology (left), foam cells (middle) and cell walls (right).

4. N₂ adsorption analysis

Thermally treated carbon materials present high surface area 800m²/g (BET), macroporosity around 40 microns and sub-micron porosity (Hg porosimetry)

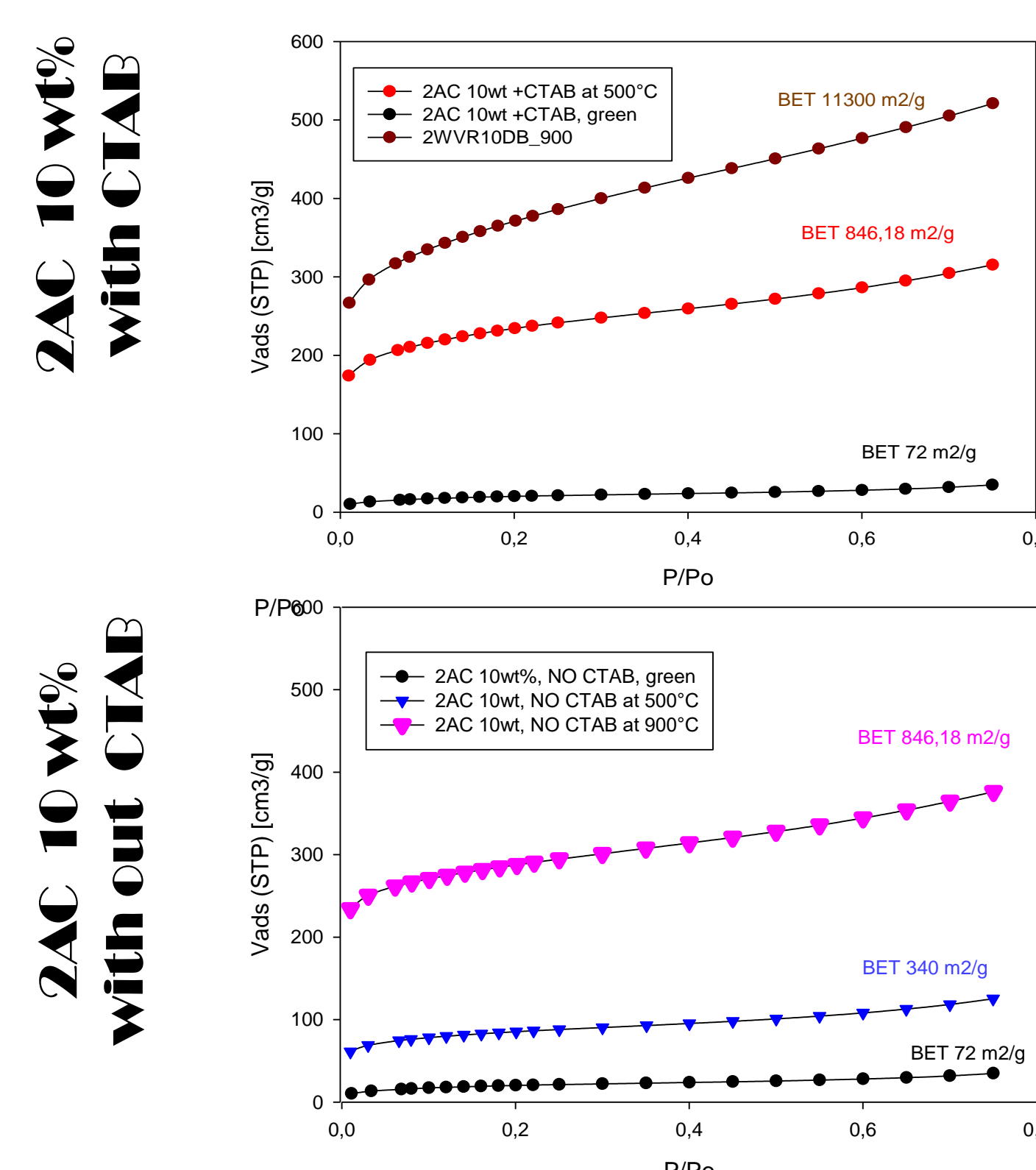
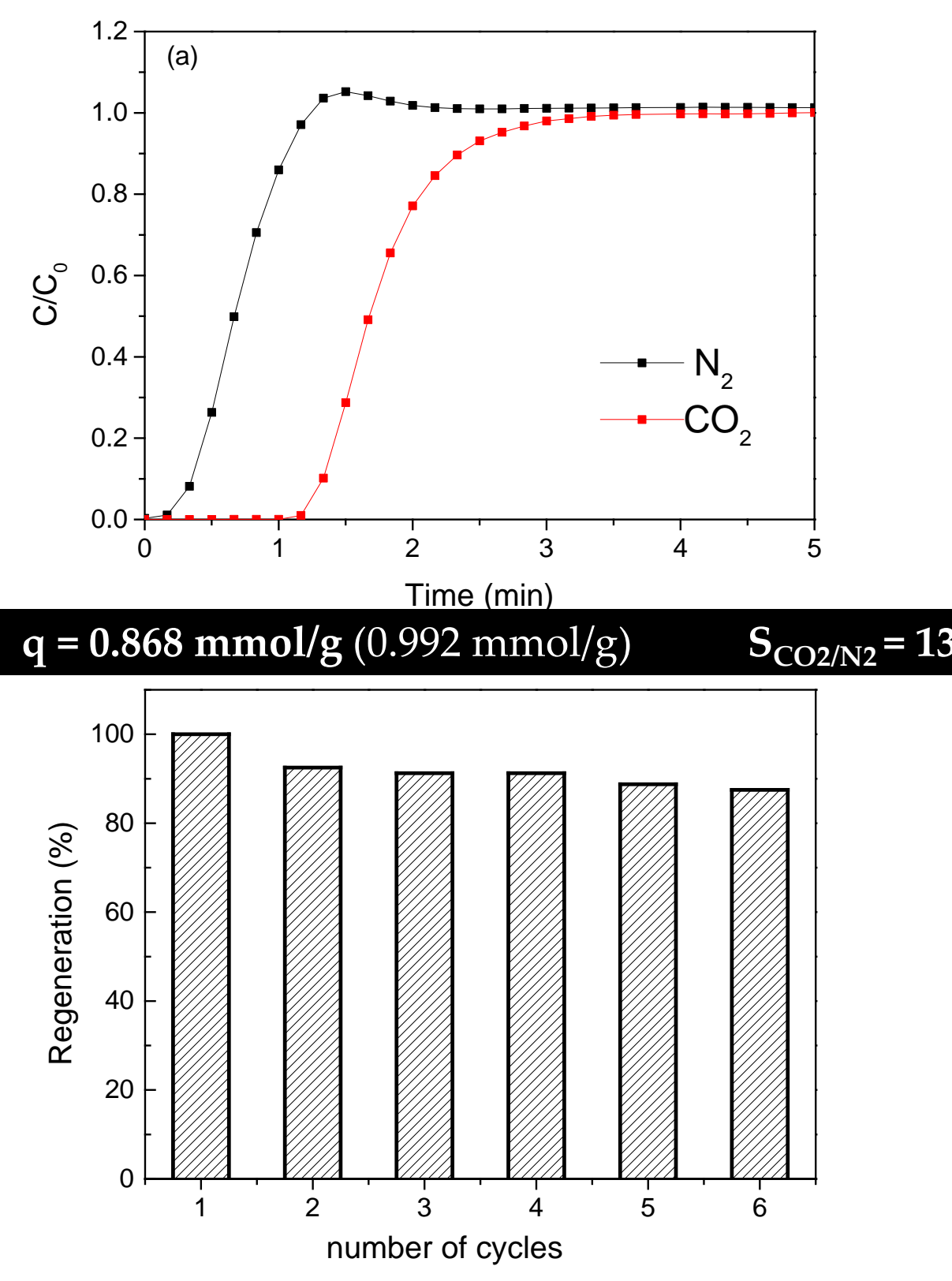


Figure 4 - N₂ adsorption curves for thermally treated carbon materials, with (a) and without CTAB (b), recorded during BET experiments, at 77K

5. Dynamic adsorption

Figure 5 – Breakthrough analysis of the dynamic adsorption of final solid AC foam (top), together with selectivity and reversibility analysis of AC carbon foam (down) after thermal treatment at 900°C.



✓90% adsorption capacity retention
✓Adsorption energy = 22 kJ/mol

Literature:

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