

Supplementary Information

Microwave synthesis of carbon nanofibers – The influence of MW irradiation power, time, and amount of catalyst

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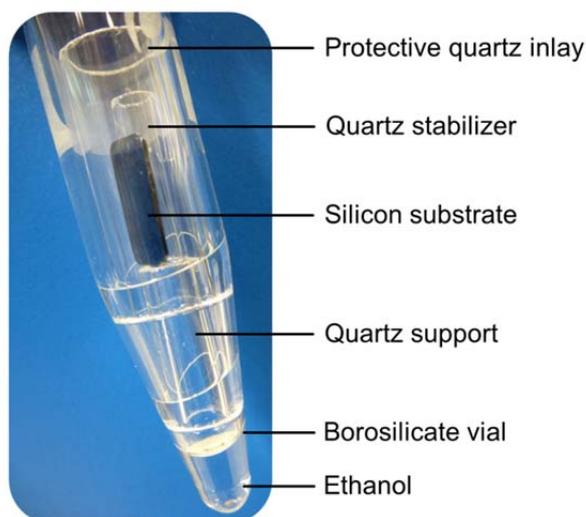


Figure 1. Photograph of the experimental set-up for the synthesis of carbon nanofibers by microwave heating.

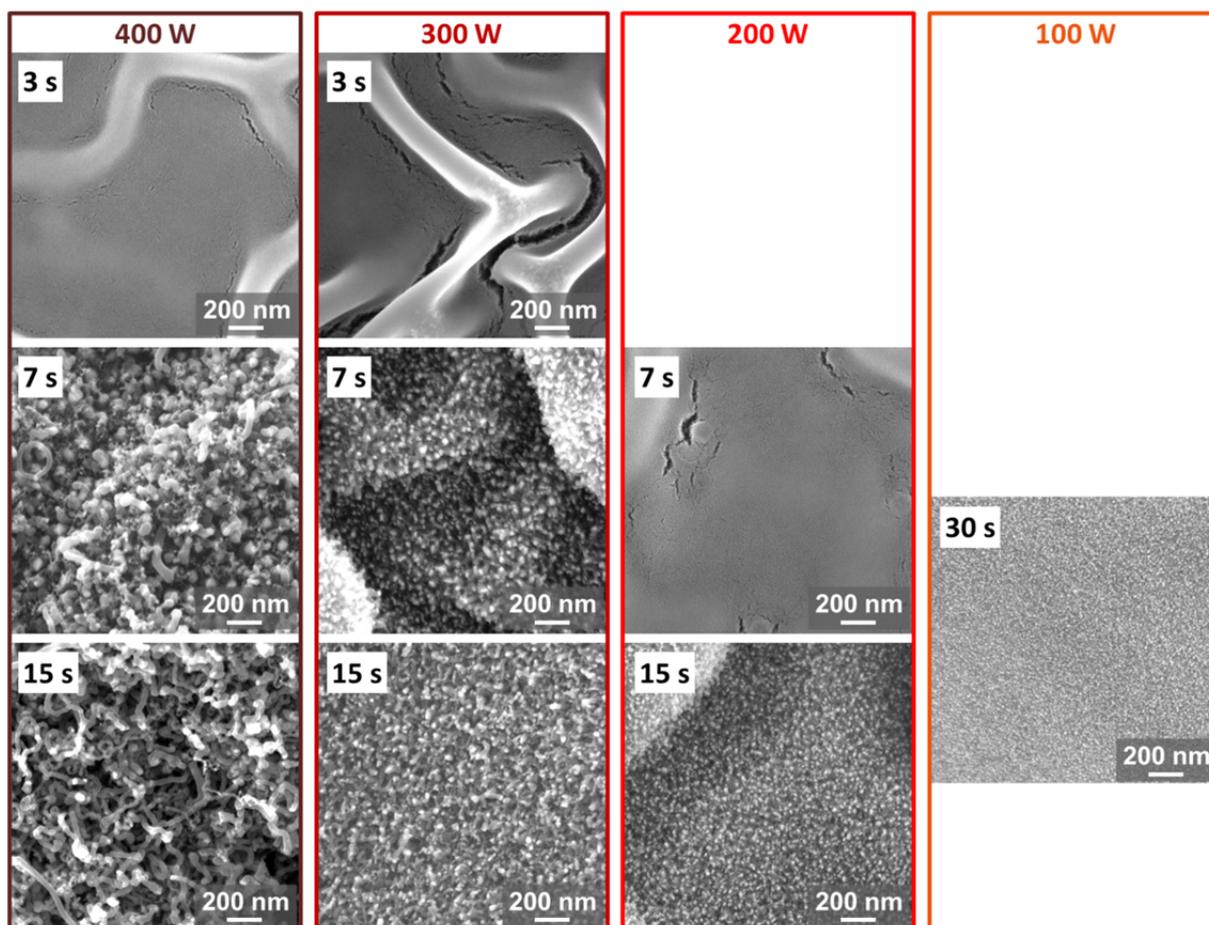


Figure 2. SEM images of the structures obtained after short microwave irradiation of 100 to 400 W before the CNF growth started. The 200 mM nickel acetate solution was applied as catalyst.

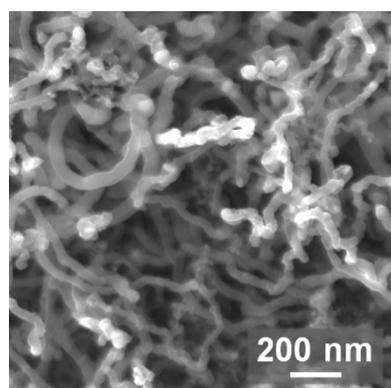


Figure 3. SEM image of CNFs prepared at 200 W irradiation power for 430 s using a 200 mM nickel acetate solution.

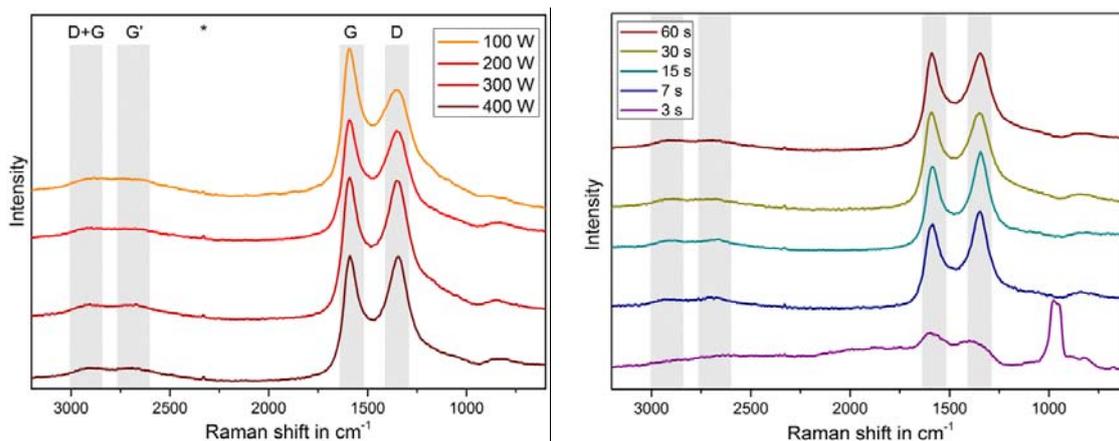


Figure 4. Left: Raman spectra of CNFs prepared with microwave irradiation for 60 s (400, 300 and 200 W) and 470 s (100 W), respectively. These conditions relate to the structures shown in Figure 1 (lower row). The typical peaks for carbon nanomaterials can be identified. The peak marked with * can be assigned to the Raman mode of N₂ gas present in the air surrounding the sample. Right: Raman spectra of CNFs prepared at 400 W with different irradiation times. The carbon peaks can be clearly identified after an irradiation time of 7 s.

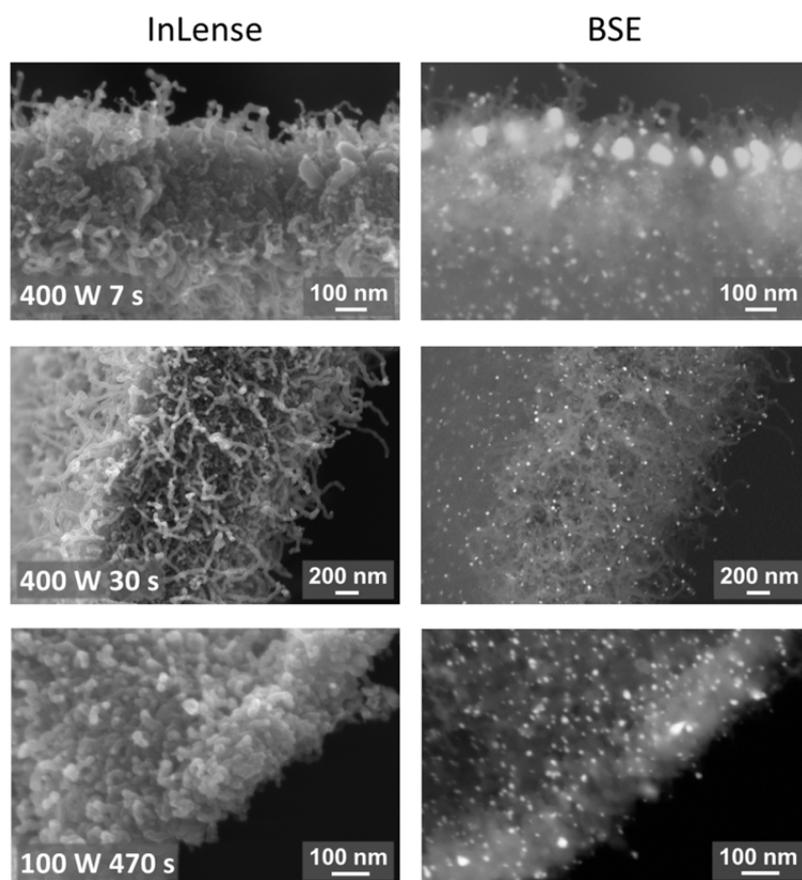


Figure 5. SEM images showing the topography (InLens detector) and the material contrast (back-scattered electron (BSE) detector) of CNFs prepared at different reaction conditions using a 200 mM nickel acetate solution. The brighter areas indicate material with higher atomic number, hence the nickel catalyst particles.

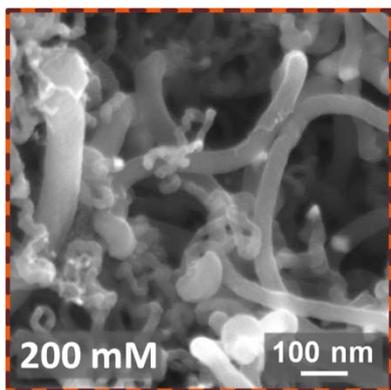


Figure 6. SEM image of CNFs prepared with two irradiation steps, 30 s at 100 W followed by 30 s at 400 W, using a 200 mM nickel acetate solution.

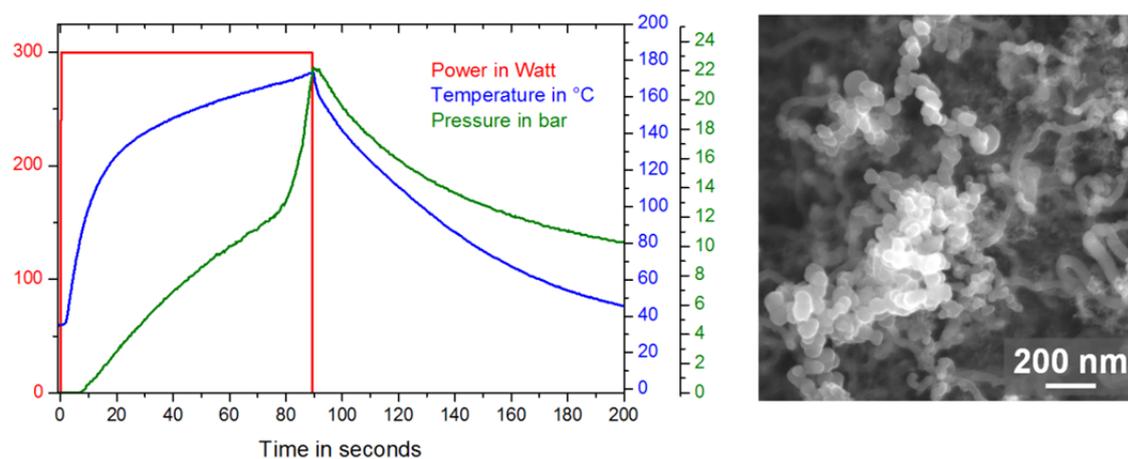


Figure 7. Microwave data and SEM image of CNFs prepared at 300 W irradiation power for 90 s using a 200 mM nickel acetate solution. After 75 s of irradiation a strong increase of pressure occurred, which is an indicator for the formation of a large amount of carbon material. SEM imaging revealed the formation of carbon nanoparticles supported on the earlier grown CNFs.

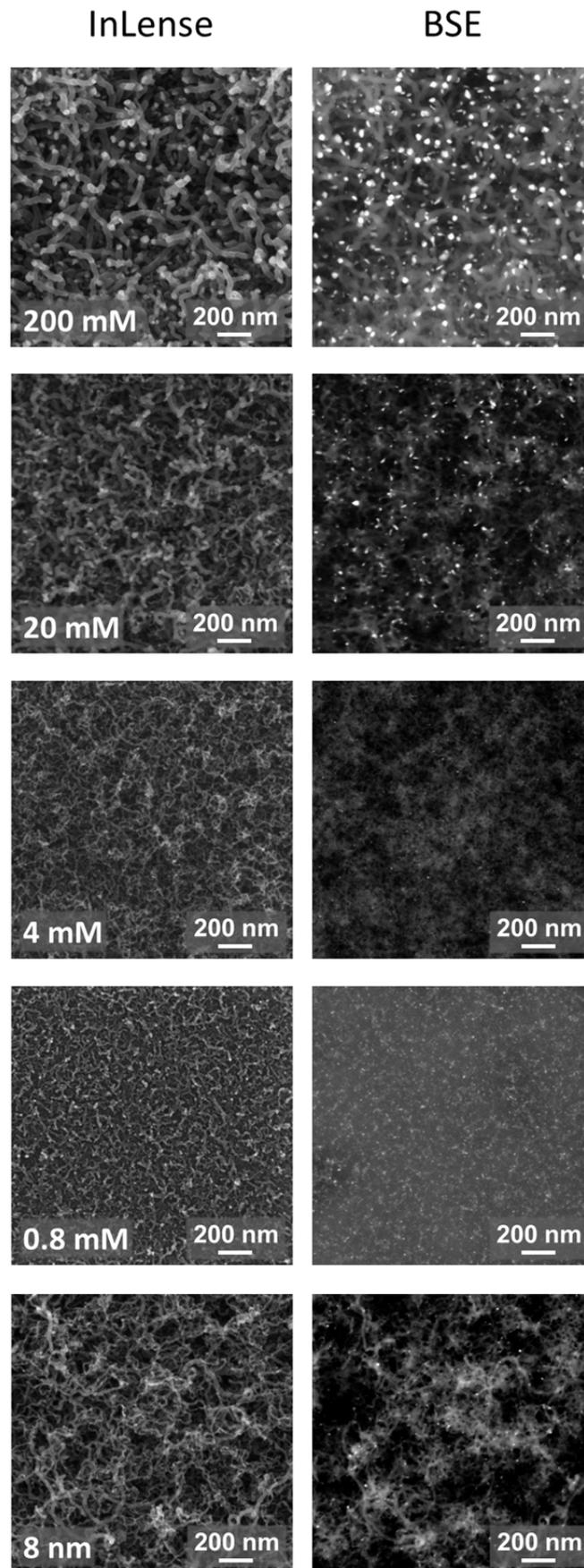


Figure 8. SEM images showing the topography (InLens detector) and the material contrast (back-scattered electron (BSE) detector) of CNFs prepared at 400 W using different amount and type of catalyst. The brighter areas indicate material with higher atomic number, hence the nickel catalyst particles.

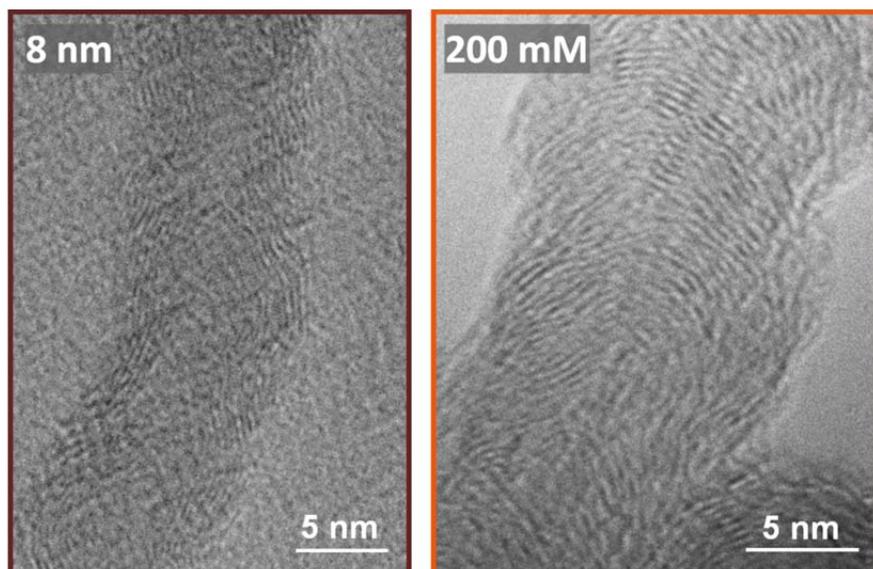


Figure 9. HR-TEM images of the structural morphology of carbon nanofibers prepared with a 8 nm nickel catalyst layer at 400 W microwave irradiation power for 15 s and a 200 mM catalyst solution at 100 W microwave irradiation power for 470 s, respectively.

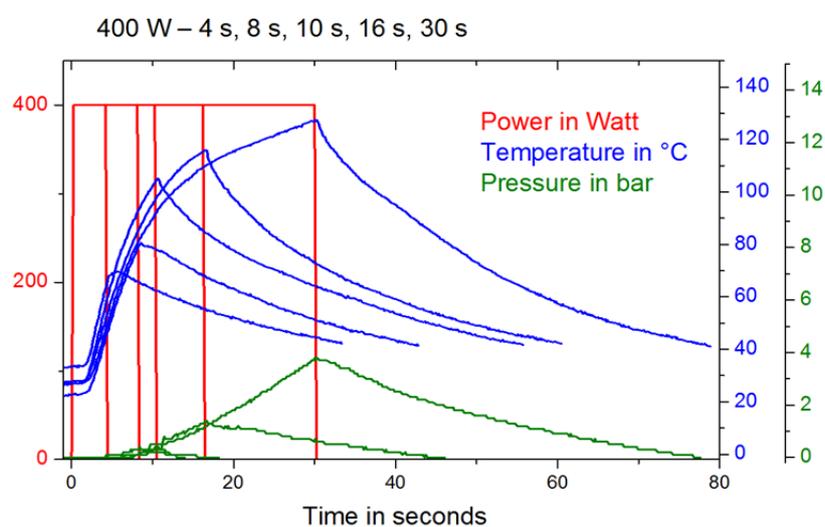


Figure 10. Power, temperature and pressure curves obtained during the synthesis of CNF at 400 W microwave irradiation power for 4 to 30 s using a 20 mM catalyst solution.

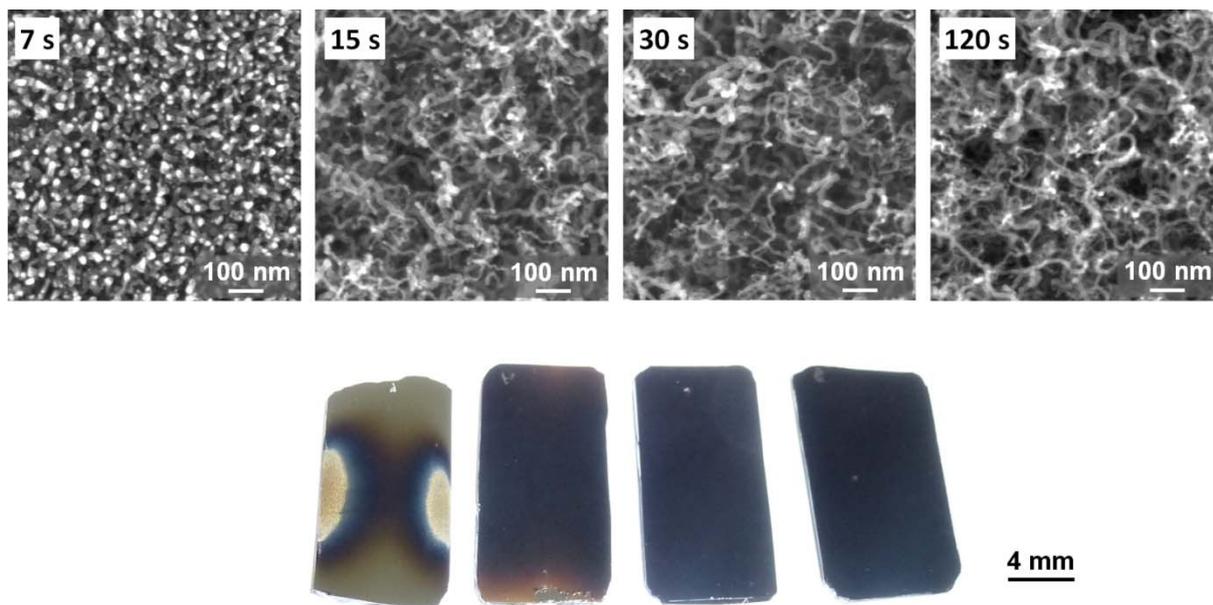


Figure 11. SEM images and photographs from CNF samples prepared utilizing a 8 nm thick nickel catalyst layer and microwave irradiation of 400 W for 7 to 120 s.

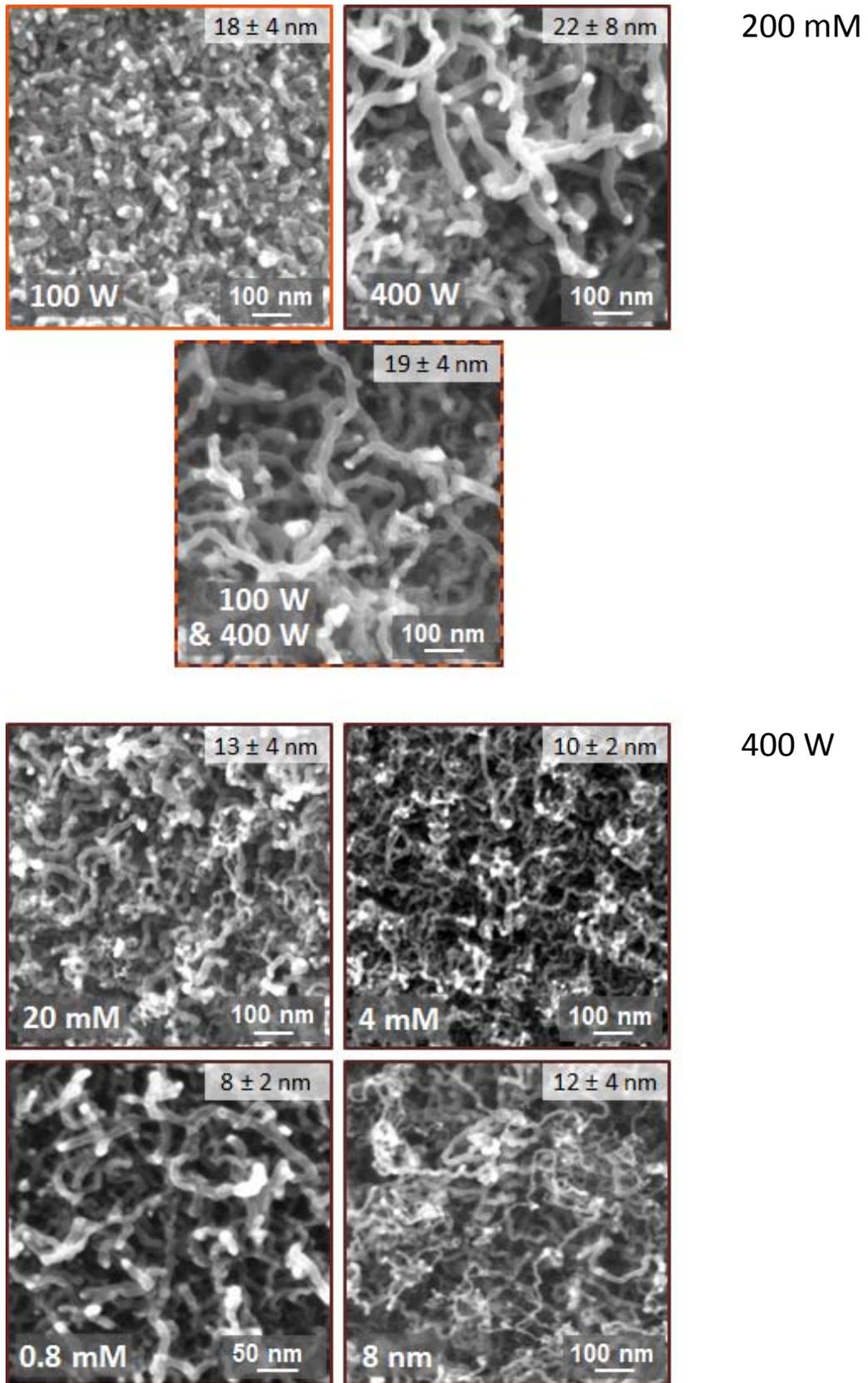


Figure 12. Examples of top-view SEM images used for the determination of the diameter distribution of carbon nanofiber coatings prepared at various conditions.