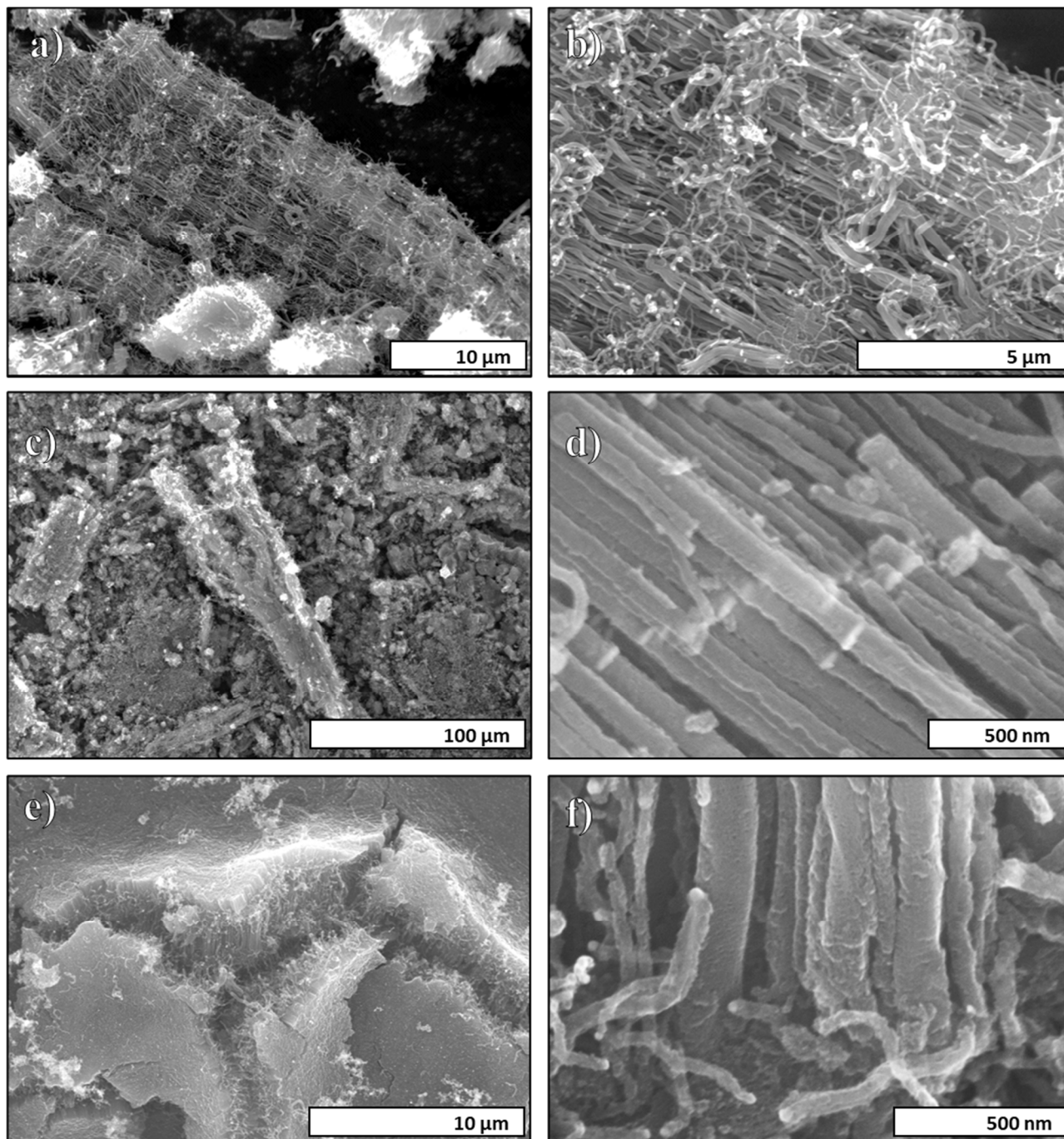
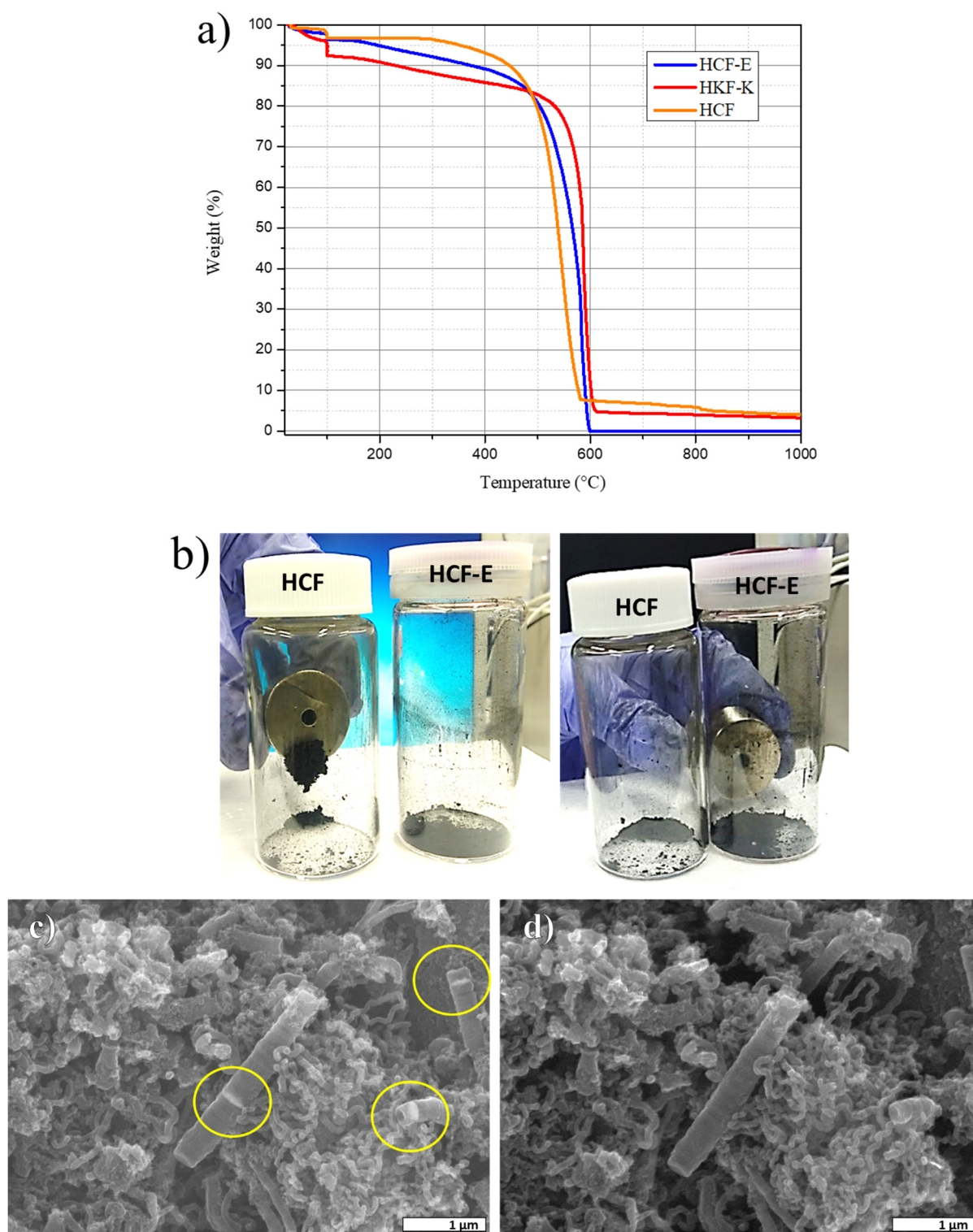


SUPPLEMENTARY INFORMATION

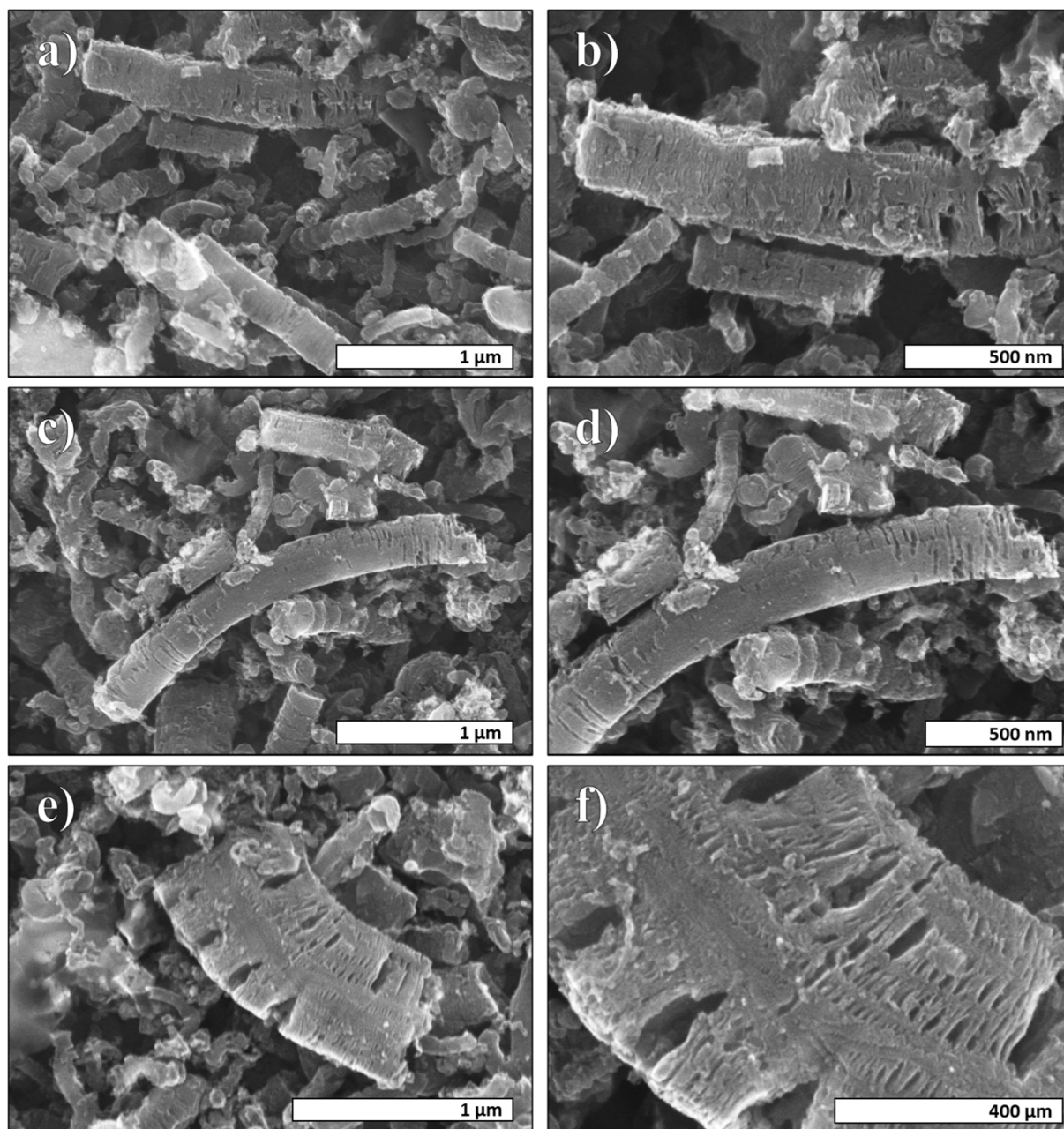
**Figure S1.** HCF bundles



a, b) HCF bundle with segments. c) Long HCF consisting of columnar fibers with Ni nodules (d). e, f) crack on the deposited planar carbon layer that exposes columnar architecture.

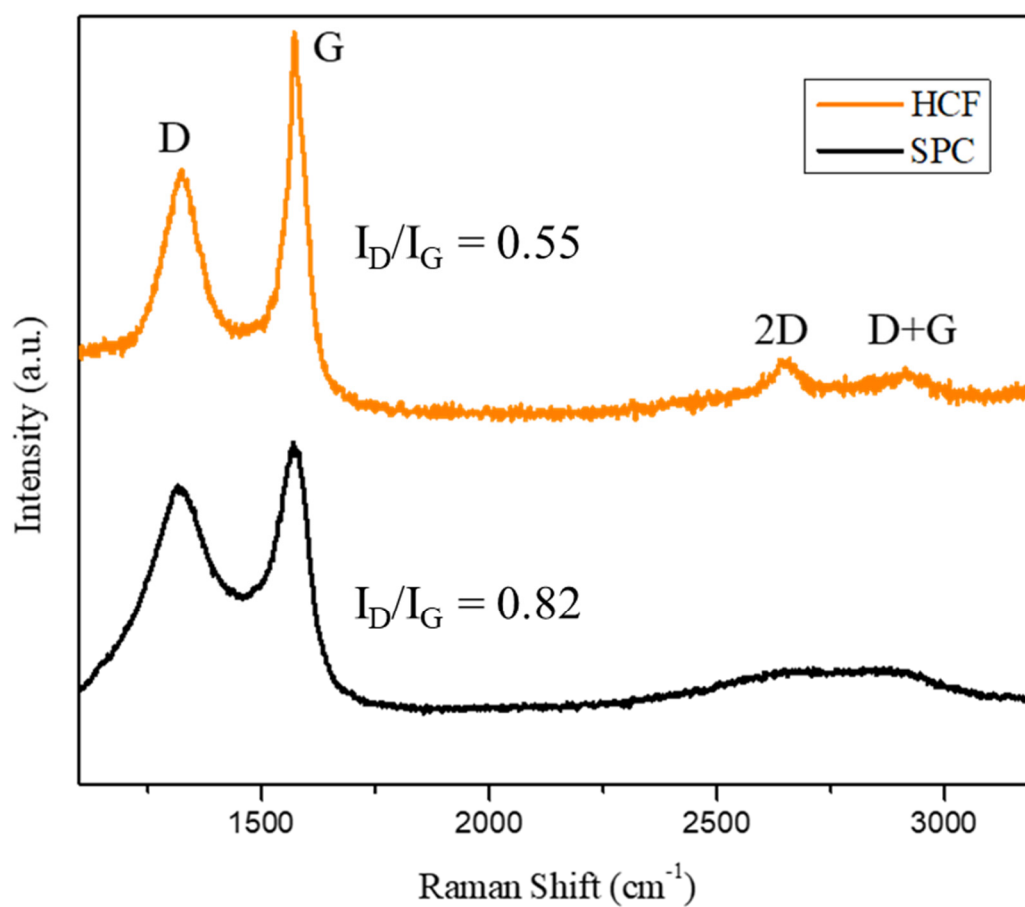
**Figure S2.** Thermogravimetric analysis (TGA) and metal content

a) Thermogravimetric analysis TGA. b) Magnetism in HCF. c, d) SEM micrographs of before – after Ni etching.

**Figure S3.** HCF-K Surface defects on individual fibers and cavities (lamellar structure)

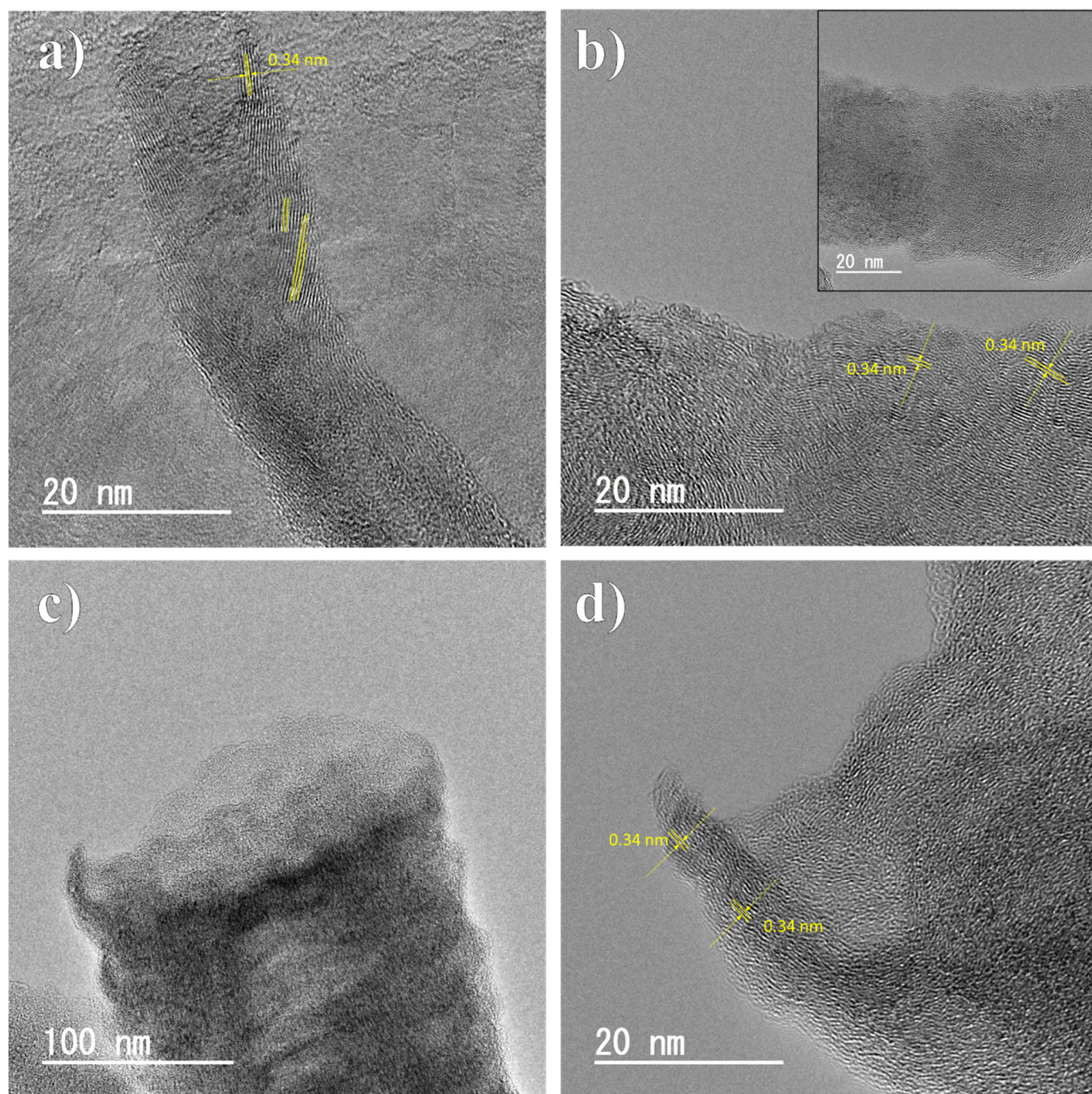
a-f) HCF-K, segments of treated fibers that show cavities, defects and lamellar structure.



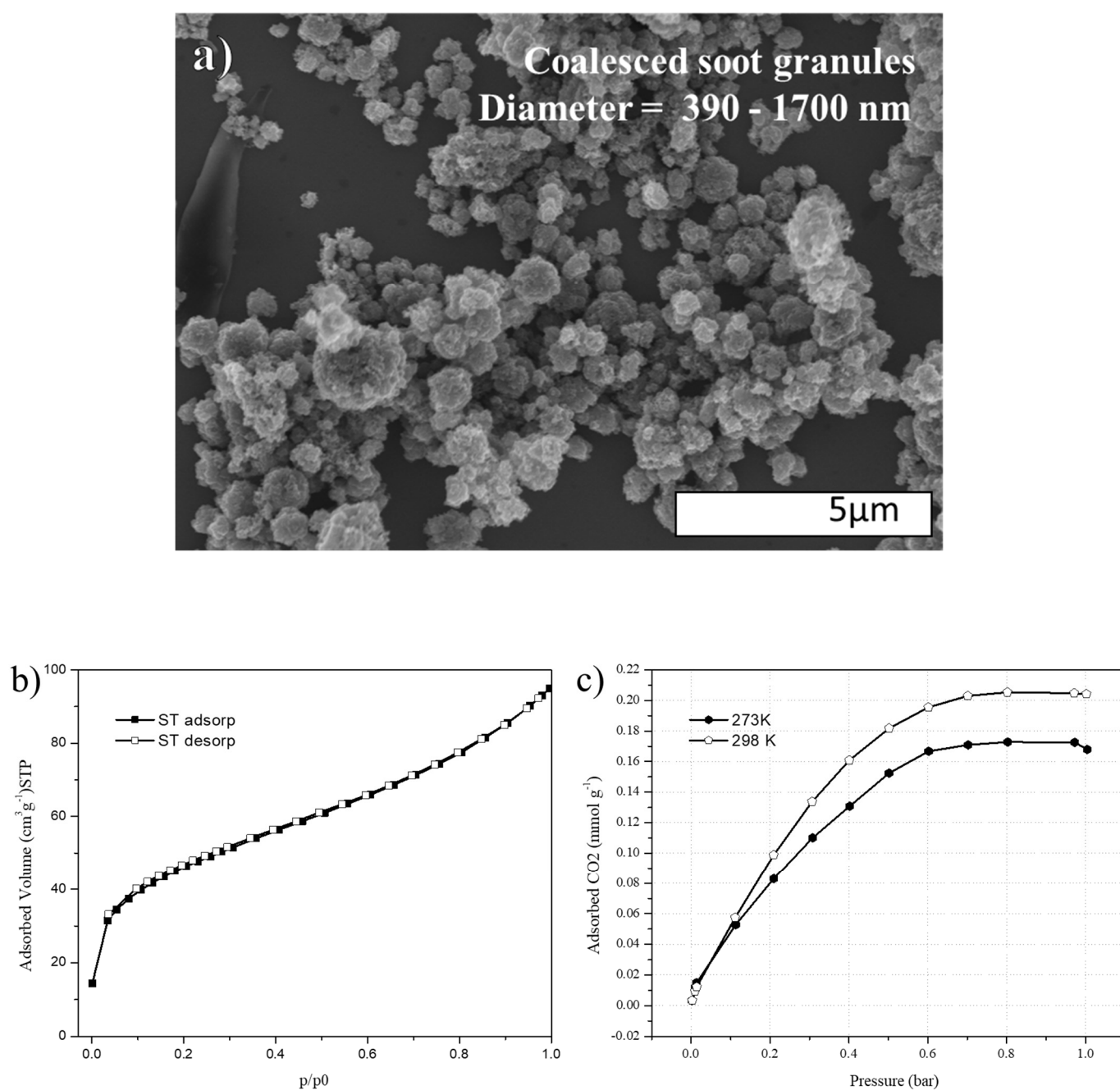
**Figure S4.** Raman Analysis

a) Raman profile of HCF and SPC synthesized parallelly.

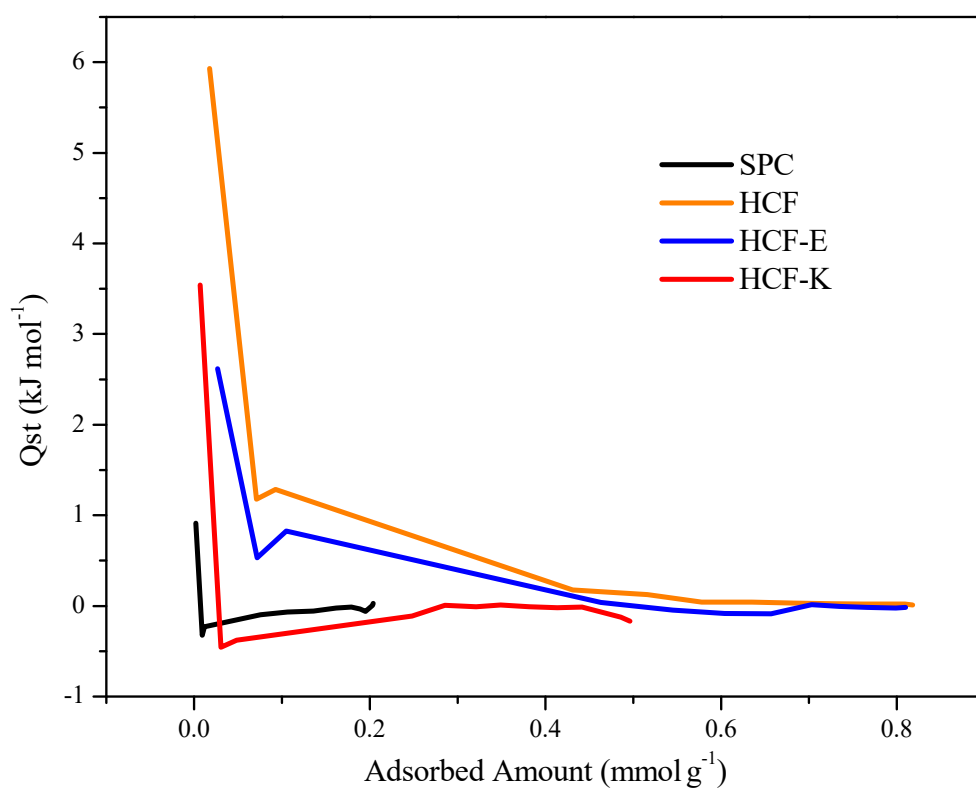


**Figure S5.** Turbostratic growth of fibers

a) TEM image that shows the “cup” stacking of graphitic layers of a fiber with narrow diameter (20nm). Ordered layers are seen near the superior edges and along the growth axis. b) turbostratic stacking of graphitic layers. c, d) thicker fiber (>100 nm in diameter) with amorphous center.

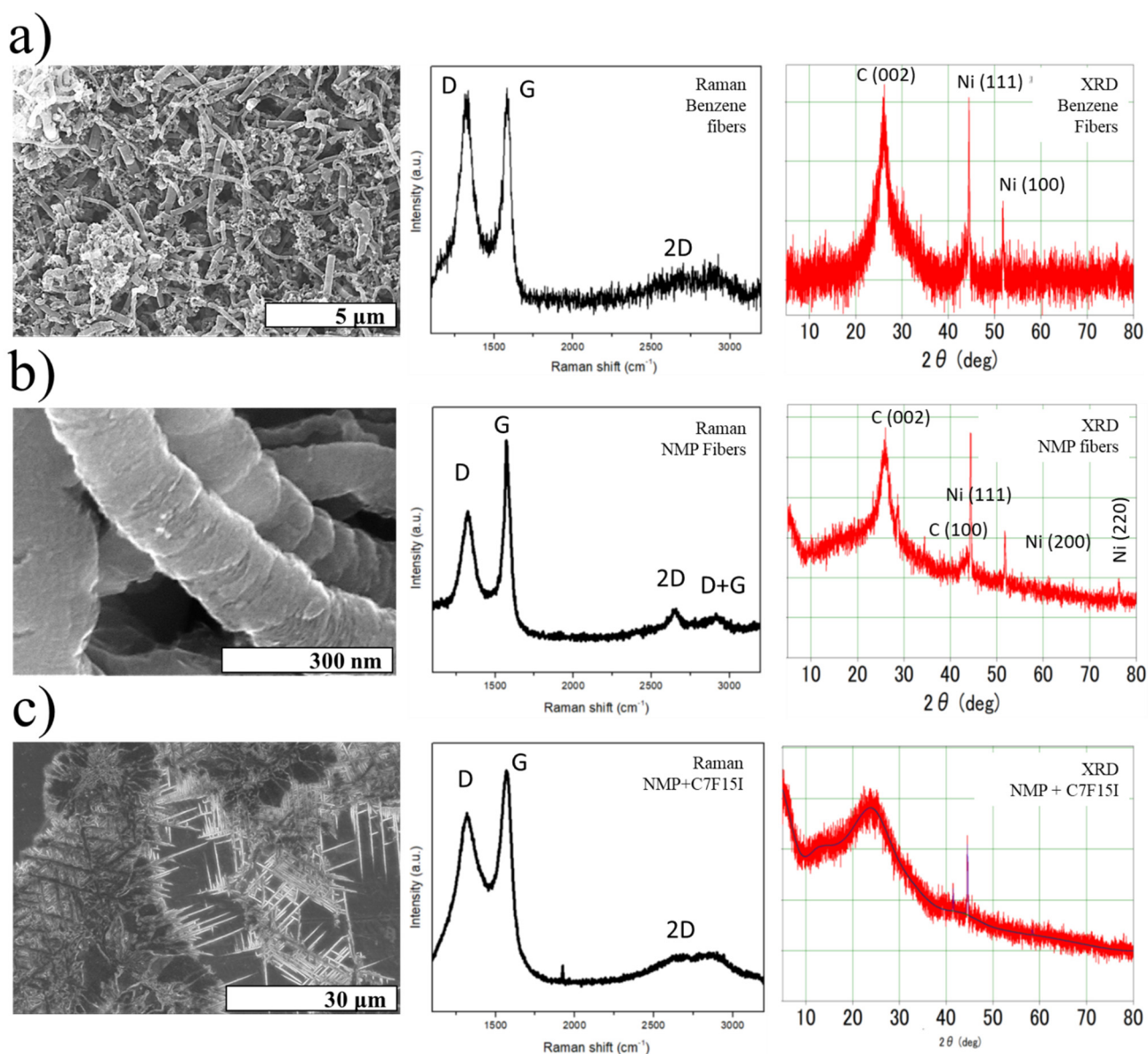
**Figure S6.** Soot characterization (ST)

a) SEM image of collected soot inside the heating chamber. This material didn't enter in contact with the nickel substrate. Particles coalesced and formed granules of different sizes. b) Adsorption-desorption isotherm of granular soot (ST), showing a type II isotherm measured at 77 K. c) CO adsorption isotherms of ST at 298 and 273K.

**Figure S7.** Isosteric heats of CO<sub>2</sub> adsorption

Isosteric heats of adsorption of HCFs and SPC.



**Figure S8.** Carbon fibers grown with different PGS

Examples of carbon materials grown by different PGS precursor, a) fibers grown benzene, b) Fibers grown by NMP and c) Carbon needles grown by NMP and C7F15I