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Chemical characterization of soot particles emitted by Wood-Burning Cook Stoves: A XPS and HRTEM study

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The morphology, microstructure, chemical composition, and electronic structure of soot particles emitted directly from biofuel cook stoves have been studied by high resolution transmission electron microscopy (HRTEM) and X-ray photoelectron spectroscopy (XPS). In order to obtain freshly emitted soot particles, copper grids for Transmission Electron Microscope (TEM) were placed on the last two of an 8-stages MOUDI cascade impactor. The analysis of HRTEM micrographs revealed the nanostructure and the particle size of soot chain. Additionally, the morphology of soot particles was analyzed calculating the border-based fractal dimension (Df). Particles sampled on the first heating stage exhibit complex shapes with high values of Df, which are present as aggregates formed by carbon ceno-spheres. The XPS survey spectrum for soot particles shows that the main particle composition is carbon. We also observed differences in the carbon/oxygen (C/O) ratio of the particles, which probably depends on the combustion process efficiency of each cook-stove analyzed. The XPS C-1s spectra show carbon with two peaks that correspond to sp2 and sp3 hybridization.
Also, real-time absorption (βa) and scattering (αs) coefficients of the particles emitted by cook stoves were measured. The trend in βa and αs indicate that the cooking process has two important combustion stages which varied in its flaming strength, being vigorous in the first stage and soft in the second one.