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Editorial

Formation, Emission and Control Technology of Particulate Matters during Solid Fuel Combustion

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The emission of particulate matters during anthropic activities is an environmental pollution and health hazard to countries globally, especially developing ones, which cannot be ignored [1–4]. The combustion of solid fuel including coal, biomass, and municipal solid waste, as well as the engines driving various vehicles, are major anthropic sources according to the widespread source apportionment reports of $PM_{2.5}$.

This Special Issue "Emissions, Control, and Utilization Technology of Particulate Matters" is an appropriate venue for papers in the field of emissions, control, and utilization technology of particulate matters in various combustion and energy conversion processes such as power stations and industrial furnaces to promote theory and technology related to aerosol science. The contributions of each collected specific paper are summarized in the following.

The first paper was written by Ma et al. [5], who studied the migration and transformation behavior of selenium during coal chemical looping gasification (CLG) under the impact of a CuO/Bentonite (Ben) oxygen carrier (OC) in a batch fluidized bed reactor. The addition of CuO/Ben OC apparently promoted the transformation from gaseous selenium to particulate selenium. The amount of gaseous selenium adsorbed by CuO/Ben OC was added along with the increase in the oxygen–carbon ratio (O/C). The CuO/Ben particles were utilized to complete the reduction and oxidation process, achieving a circulation process of chemical looping with low heavy-metal emission.

The second paper was written by Li et al. [6] from Zhengzhou University of Light Industry, China, in which they proposed a dielectric barrier discharge biological method to treat the possible carbonaceous particles, chlorobenzene, aiming to control high operating costs and prevent secondary pollution. The authors indicated that the degradation efficiency of the integrated system increased by 15–20% compared with that of a single biological system, which has great potential in addressing chlorobenzene pollution in the pharmaceutical and chemical industries.

The third paper was written by Li et al. [7] from Huazhong University of Science and Technology, China. They observed the processes of char fragmentation and particulate matter (PM) formation during dense and porous char combustion through a site percolation model, including the partitioning of mineral determined by a computer-controlled scanning electron microscope (CCSEM). The model presented the influence of initial pore distribution on char oxidation and fragmentation, the change in ash distributions with the char conversion, and the PM size distribution. The increase in char porosity showed a positive effect on the increase in the number and concentration of PM_{10}.

The fourth paper was written by Li et al. [8] from Ningxia University, China. They reported that the migration and transformation behaviors of sulfur and nitrogen were basically the same when $CaFe_2O_4$ and Fe_2O_3/Al_2O_3 were used as oxygen carrier (OC)

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particles, respectively, in coal chemical looping combustion (CLC). The increase in the reaction temperature and oxygen-to-carbon ratio (O/C) contributed to the release of sulfur and nitrogen and higher reaction temperature and O/C could inhibit the formation of metal sulfide. O_2 released by $CaFe_2O_4$ significantly increased the contents of SO_2, H_2S, NO, and NO_2 in flue gas. This work is helpful for improving control strategies for gaseous precursors of particulate matter.

The fifth paper was written by Li et al. [9] from Anhui University, China. They reported an ideal air purification filter to remove inhalable particles and toxic gases. A novel coaxial core–shell CuO@NH_2-MIL-53(Al) nanowire array was synthesized on a rigid copper net based on the interaction of a local electric field and an external electric field, which was used to achieve $PM_{2.5}$ removal rates of 98.72% and 44.41%, respectively, with and without an external electric field. The air pollution removal efficiency could remain stable after repeated filtration and cleaning for 10 cycles.

The sixth paper was written by Yang et al. [10], who studied the effect of densification on biomass combustion characteristics and PM emission. The authors revealed that densification resulted in a better performance of combustion; however, the influence on PM emission was related to the biomass properties, especially ash contents and compositions.

The seventh paper was written by Wang et al. [11], who performed coal combustion with a novel nano SiO_2 additive (<100 nm) to evaluate its effects on reducing ultrafine PM. The results showed that adding a small dosage (0.6%) of nano-SiO_2 reduced the mass yield of ultrafine PM by 30.70% because it inhibited the migration of volatile alkali metals such as Na into ultrafine PM, presenting a much higher ultrafine-PM capture efficiency than the existing micron-sized natural clay mineral.

The last paper written by Li et al. [12] carried out field tests in a subcritical coal-fired power plant co-firing coal and sludge to analyze the emission characteristics of gaseous and particulate mercury. The particulate mercury (Hg_p) concentration at the ESP inlet increased significantly, accompanied by a decrease in Hg^0. The transformation of Hg^0 to Hg_p appeared to be more distinct for co-firing. The slightly higher mercury removal efficiency under co-firing (92.83%) than single coal combustion (92.12%) was attributed to the complete removal of the higher concentration of Hg_p.

The above publication covers several key research fields, including the formation mechanisms during solid-fuel combustion [7,10]; new methods of particle emission reduction [9,11]; heavy-metal hazards in particles [5,12]; field research on solid-fuel combustion [12]; carbonaceous particles and/or soot [6]; and the condensable particulate matter problem [8]. In conclusion, the findings reported in this SI provide new avenues for recognizing the up-to-date formation theory and emission and control technology of particulate matters.

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