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Supporting Information (SI)

Evolution of condensable fine particulate size distribution in flue gas by external regulation for growth enhancement

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Details of size distribution form of CFP

The size distribution of CFP is expressed as dc/dlog D_p, which can be defined by the following equation:

$$dc / d\log D_p = \frac{\Delta c}{\log D_{p,\max} - \log D_{p,\min}} \tag{S1}$$

where c and D_p refer to the concentration (cm^{-3}) and diameter (μm) of CFPs in a certain size range, respectively. $D_{p,up}$ and $D_{p,low}$ represent the maximum and minimum diameters (μm) for this size range of cascade *p*, respectively.

Details of error bars

The error bar is determined by standard error (SE), which is the quotient of the standard deviation (SD) and the square root of the sample numbers.

$$SE = \frac{SD}{\sqrt{N}} \tag{S2}$$

$$SD = \sqrt{\frac{\Sigma(X_i - \overline{X})^2}{N-1}} \tag{S3}$$

where $\overline{X}$ is the mean of the samples, and X_i is the value of the i-th sample. *N* is the number of repetitive experiments.

Details of Pearson's correlation coefficient (PCC)

PCC passed a linear correlation between two variables, and the resulting value was at [−1; 1], in which −1 indicates a complete negative correlation (as one variable increases, the other variable decreases) and +1 a fully positive correlation; 0 implies the absence of a linear correlation between the two variables. The overall PCC between the two variables is the quotient of the covariance and standard deviation of the two variables:

$$\rho_{X,Y} = \frac{cov(X,Y)}{\sigma_x \sigma_y} = \frac{E[(X-\mu x)(Y-\mu y)]}{\sigma_x \sigma_y} \tag{S4}$$

where Cov(X,Y) is the covariance between the variables X and Y; and σ_x and σ_y represent the standard deviation of variables X and Y, respectively.

The PCC of sample is computed as follows:

$$r = \frac{\sum_{i=1}^{n}(X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \overline{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \overline{Y})^2}} \tag{S5}$$

where X_i and Y_i are the ith samples of sample sets X and Y, respectively. $\overline{X}$ and $\overline{Y}$ are the average values of the sample sets X and Y, respectively; n is the number of samples.

Figure S1. Solid aerosol generator. The feed process mainly included two steps. First, a certain amount of fly ash was quantitatively transmitted by a conveying belt, and the amount of ash could be precisely adjusted by controlling the belt speed. The transmission teeth were arranged on the belt. The fine teeth pitch ensured the continuous and stable feed of fly ash. At the same time, a special scraping device was arranged to ensure the uniformity of the filling. The compressed air could then disperse particles to the greatest extent to reduce the agglomeration of fly ash. The generator was connected with compressed air to form a negative pressure at the venturi tube. When the fly ash on the conveyor belt was transferred to the nozzle of the venturi tube, it could be dispersed into the flue gas under negative pressure. Similar to NH_3, the flow rate of feeding ash was sufficiently small to not affect the temperature and flow field of simulated flue gas.

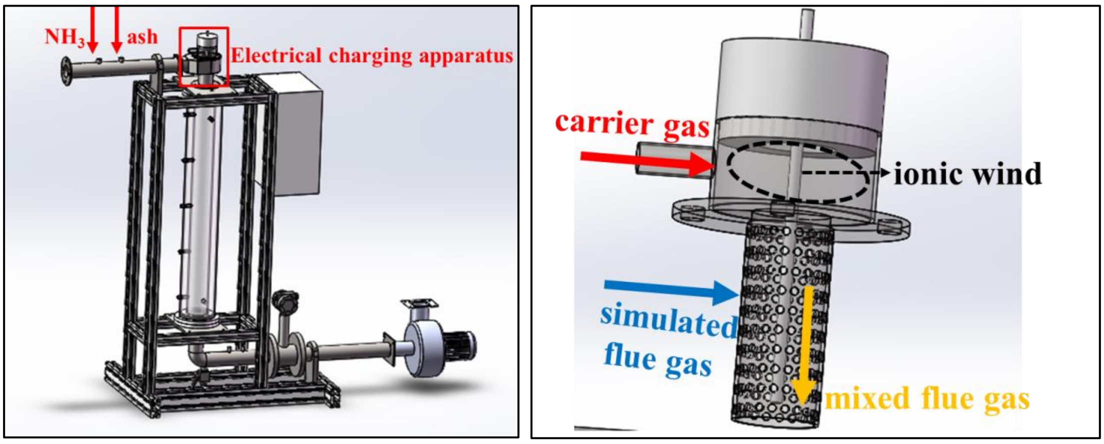

Figure S2. Three-dimensional schematic of electrical charging apparatus. Under discharge condition, the growth and capture of CFP are the simultaneous processes that simultaneously affect each other. To study the process of growth independently, we designed a new structure with polar wire discharge at the center of the hollow steel shell on top of the growth tube (Figure 3). Ionic wind with charged particles flew into the growth tube by carrier gas. Insulation material was used to isolate other parts except the wire to minimize the removal of condensable particles caused by the electrical field. The flow rate of carrier gas was determined by the flow rate of the mixing zone. The determination principle was the given aperture ratio and the amount of carrier gas, and the flow rate of the carrier gas was equal to the flow rate of the mixing zone. At 60 L/min main flue gas, the flow rate of the carrier gas reached 4.71 L/min. The carrier gas was first flowed through a gas washing bottle and then heated to the same temperature as the main flue gas for mixing to reduce the effect of carrier gas on the humidity and temperature of the main simulated flue gas.

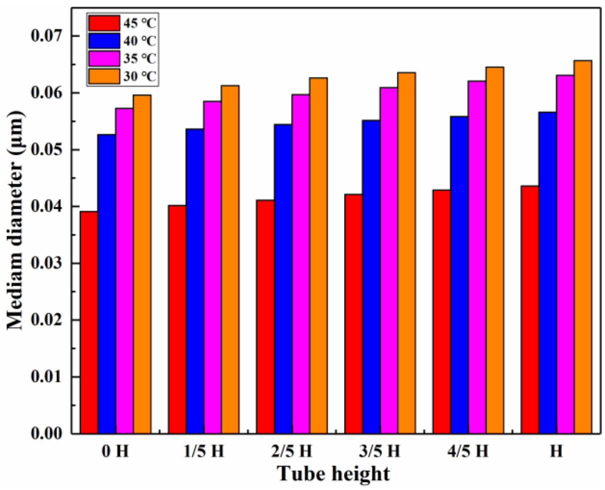

Figure S3. Medium diameter of CFPs under different temperatures

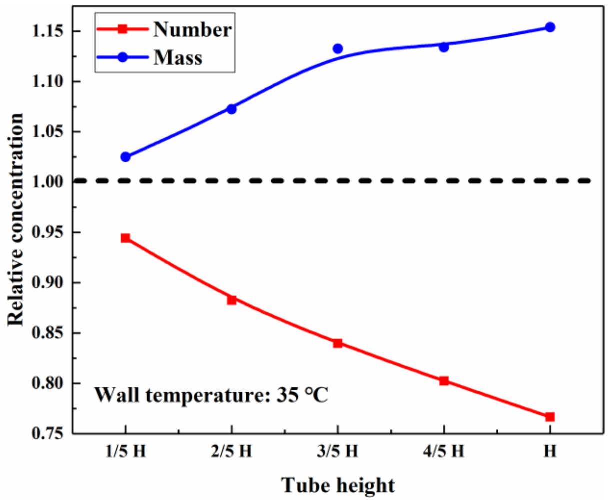

Figure S4. Relative concentration of CFPs after cooling