Appendix A: Error analysis

For the ACR through the CCFU, the random errors under R1-B1-2 and R1-B1-3 conditions are 2.92% and 3.87%, respectively. The systematic errors are 5%. So the measurement errors under R1-B1-2 and R1-B1-3 conditions are 7.92% and 8.87%, respectively. For the ACR of infiltration air, the random errors under R1-B1-1, R1-B1-2 and R1-B1-3 conditions are 6.60%, 3.38% and 5.00%, respectively. According to the calculation equation of the ACR of infiltration air, the transfer function of the error can be expressed as Eq.(A.1):

$$\Delta\lambda_L = \frac{1}{\Delta t}\times\left|\frac{1}{C_a - C_{bg}}\right|\Delta C_a + \frac{1}{\Delta t}\left|-\frac{1}{C_a - C_{bg}} + \frac{1}{C_f - C_{bg}}\right|\Delta C_{bg} + \frac{1}{\Delta t}\times\left|-\frac{1}{C_f - C_{bg}}\right|\Delta C_f \quad \text{(A.1)}$$

After calculation, the transfer errors under R1-B1-1, R1-B1-2 and R1-B1-3 conditions are 0.21%,0.12% and 0.20%, respectively. Therefore, the comprehensive errors of the measurement on the ACR of infiltration air are 6.81%, 3.50% and 5.20%, respectively.

For the PM penetration factor, the steps can be taken to obtain the error of the penetration factor for particles with different sizes. The equation to calculate the PM penetration factor is Eq.(A.2).When differential is made on the above equation, we can obtain:

$$\ln P = \ln\left(\frac{I}{O}\right) + \ln\left(\frac{\beta}{\lambda_L} + 1\right) \quad \text{(A.2)}$$

When derivative is made on the above equation, we can obtain:

$$\frac{\Delta P}{P} = \frac{\Delta\left(\frac{I}{O}\right)}{\left(\frac{I}{O}\right)} - \left(\frac{\beta}{\beta + \lambda_L}\right)\frac{\Delta\lambda_L}{\lambda_L} \quad \text{(A.3)}$$

By calculation, the errors of the penetration factor for particles with size 0.3-0.5μm, 0.5-1.0μm,

1.0-3.0μm, 3.0-5.0μm and 5.0-10μm are 10.46%, 21.39%, 11.28%, 27.13% and 26.73%, respectively. Uncertainties of parameters are shown in Table A.1.

Table A.1 Uncertainties of parameters.

ACR of recirculating air			ACR of infiltration air			Penetration factor				
R1-B1-1	R1-B1-2	R1-B1-3	R1-B1-1	R1-B1-2	R1-B1-3	0.3-0.5μm	0.5-1.0μm	1.0-3.0μm	3.0-5.0μm	5.0-10μm
0	7.92%	8.87%	6.81%	3.50%	5.20%	10.46%	21.39%	11.28%	27.13%	26.73%