Supporting Information

Enhanced immunofluorescence detection of protein marker using PAA modified ZnO nanorod array-based microfluidic device

Zhihua Wu‡[a], De Zhao‡[b], Chengyi Hou[a], Lei Liu[b], Jianhua Chen[c], Hui Huang[b], Qinghong Zhang[a], Yourong Duan*[b], Yaogang Li*[a], Hongzhi Wang*[a]

Figures

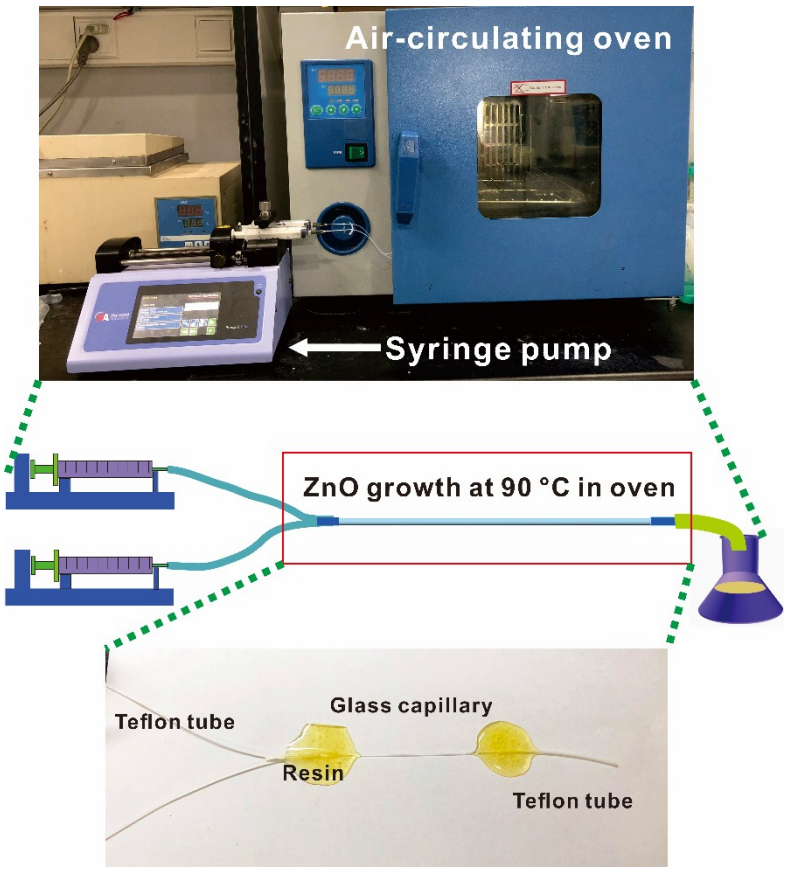

Fig. S1 Photographs of fabrication process and the microfluidic device. The diameter of the glass capillaries is about 500 μm. The whole length of capillaries is 10 cm, and the available part is 5-8 cm. As shown in Fig. S1, the capillary was placed in air-circulating oven to maintain the reaction temperature at 90℃. Glass capillary was sealed using resin to ensure the airtightness. Besides, ZnO nanorods can be constructed in the innerwall of glass with the capillary diameter of 100-900 μm.

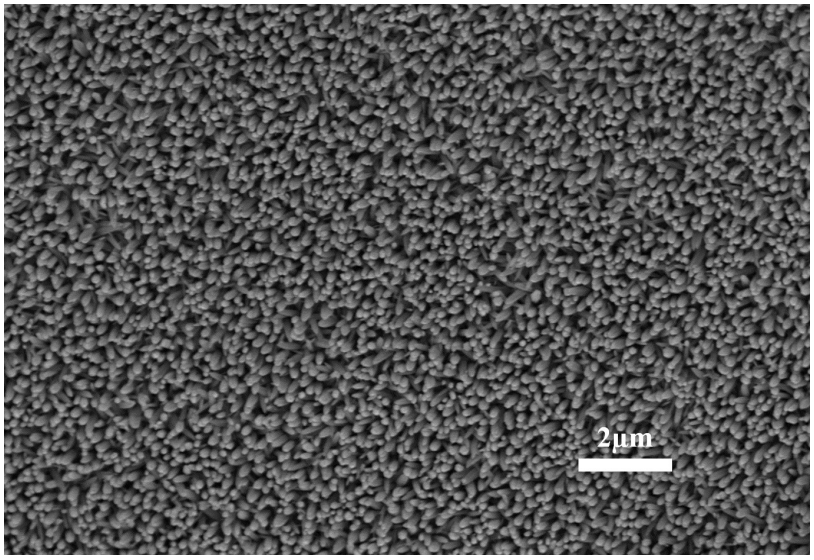

Fig. S2 Low-magnification SEM image of ZnO-Ⅲ nanorod arrays.

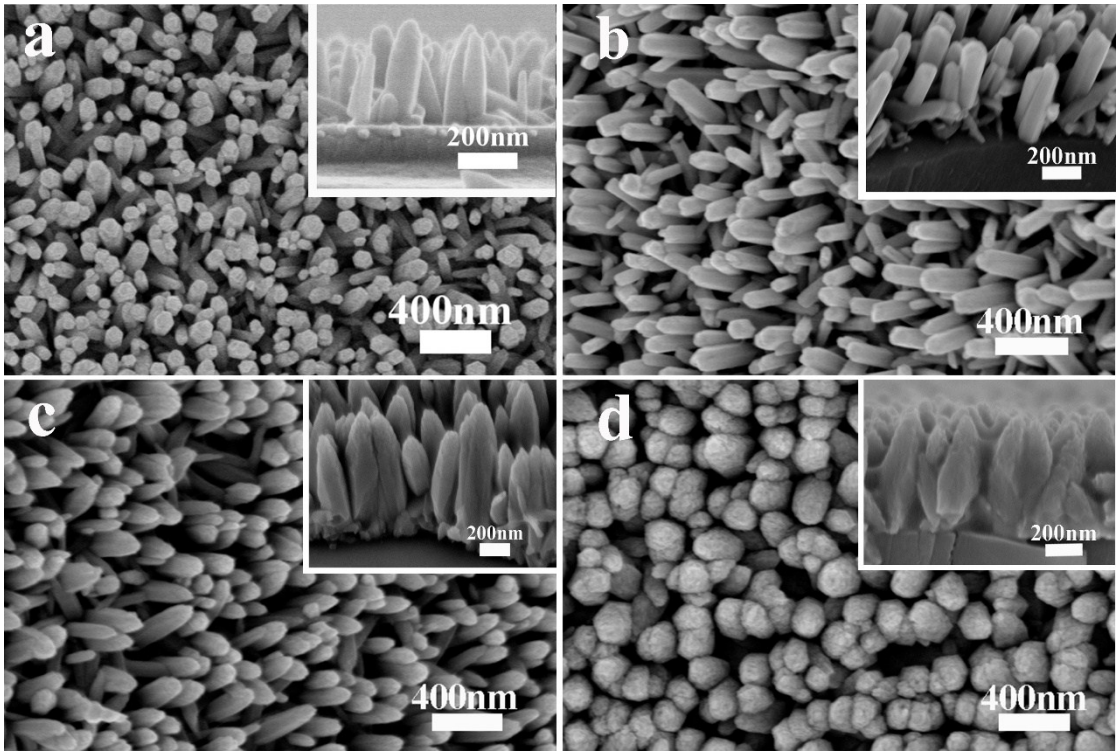

Fig. S3 SEM images of ZnO nanorods grown in capillaries at 90 ℃ with the Zn^{2+} concentration of 0.10 M, 5 min at the rate of 0 μL•min^{-1} (a) (ZnO-Ⅴ), repeat (a) for another 5 min (b) (ZnO-Ⅵ), 4 min at the rate of 25 μL•min^{-1} (c) (ZnO-Ⅶ), and 2 min at the rate of 50 μL•min^{-1} (d) (ZnO-Ⅷ).

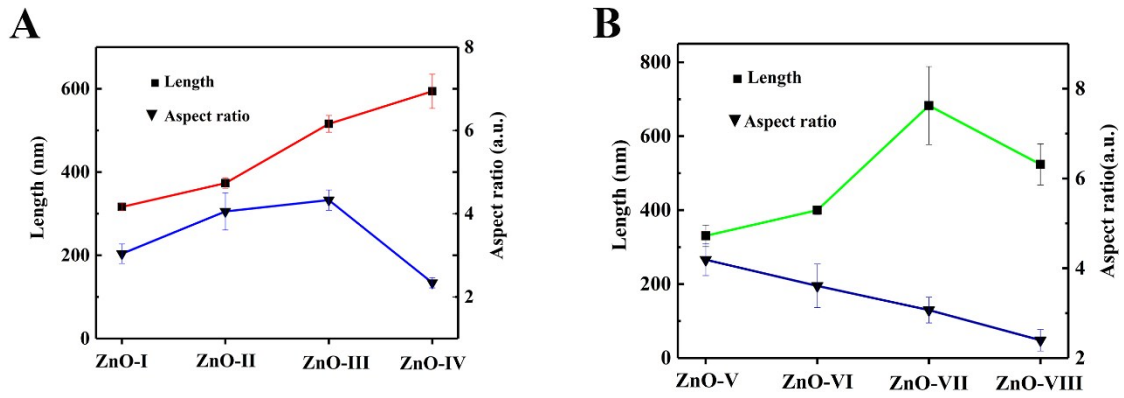

Fig. S4 Statistics of aspect ratio and length of ZnO nanorods prepared with different reaction solution concentration, (A) 0.05 M (ZnO- Ⅰ ~ ZnO-Ⅳ), (B) 0.10 M (ZnO-Ⅴ ~ ZnO-Ⅷ).

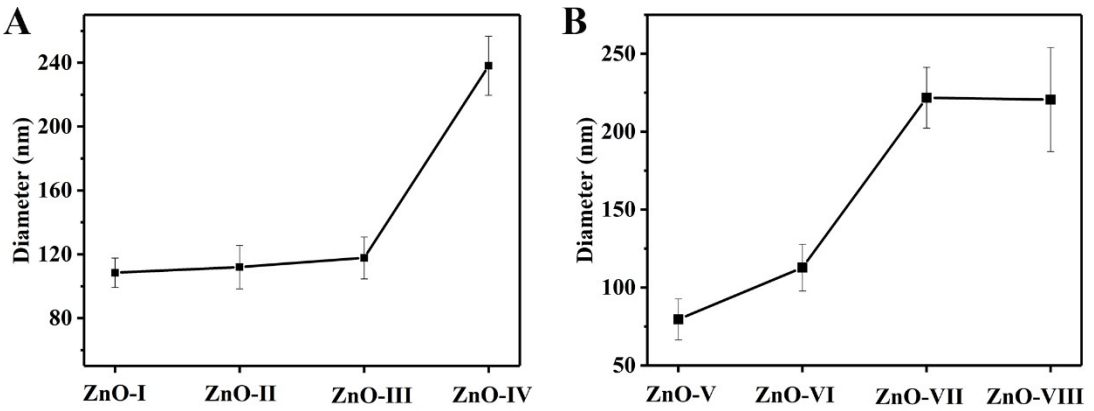

Fig. S5 Statistics of diameter of ZnO nanorods prepared with different reaction solution concentration, (A) 0.05 M (ZnO- Ⅰ ~ ZnO-Ⅳ), (B) 0.10 M (ZnO-Ⅴ ~ ZnO-Ⅷ).

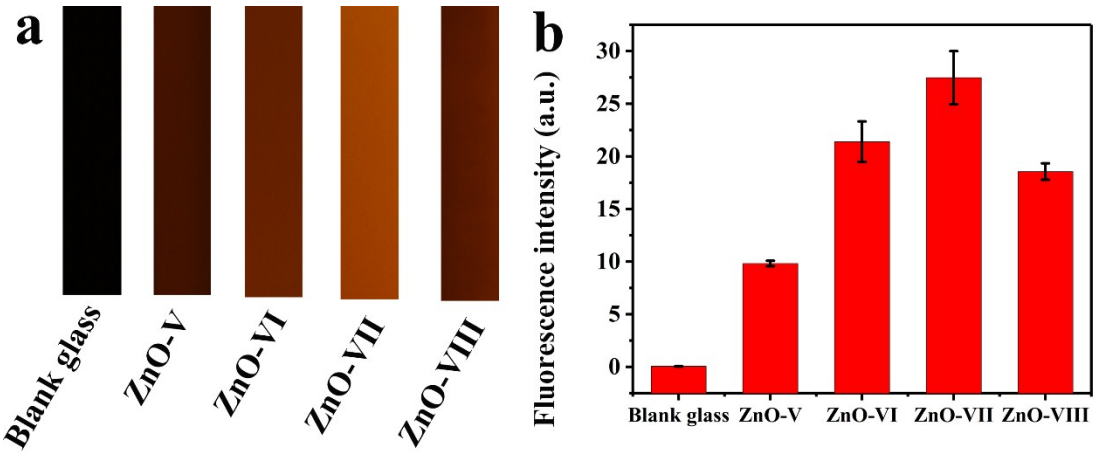

Fig. S6 Comparison of fluorescent enhancement of ZnO nanorods with with Zn^{2+} concentration of 0.10 M, (a) Fluorescent images, (b) the corresponding fluorescence intensity comparison of (a).

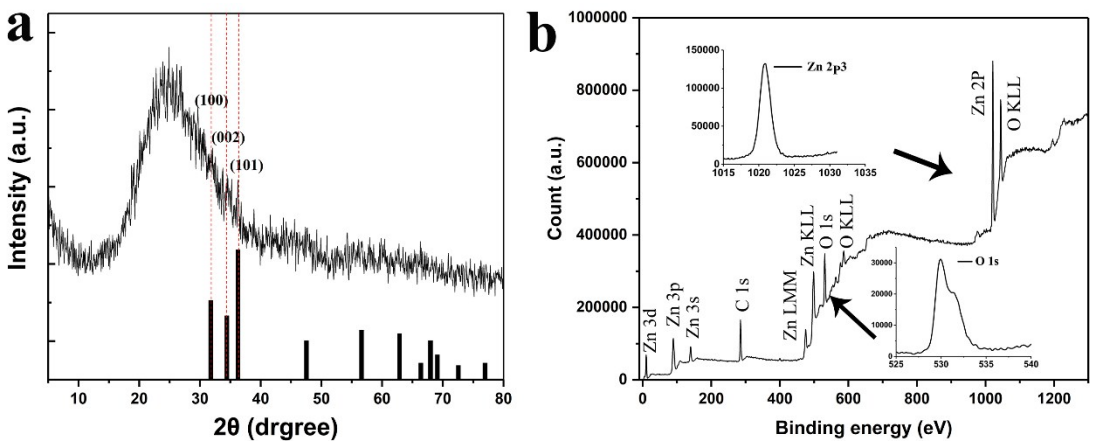

Fig. S7 (a) Powder-XRD pattern of ZnO nanorods. Due to the high content of glass in powder sample, it shows a broad diffraction peak positioned at 2-theta angles of 25, (b) XPS survey spectrum of ZnO nanorods.

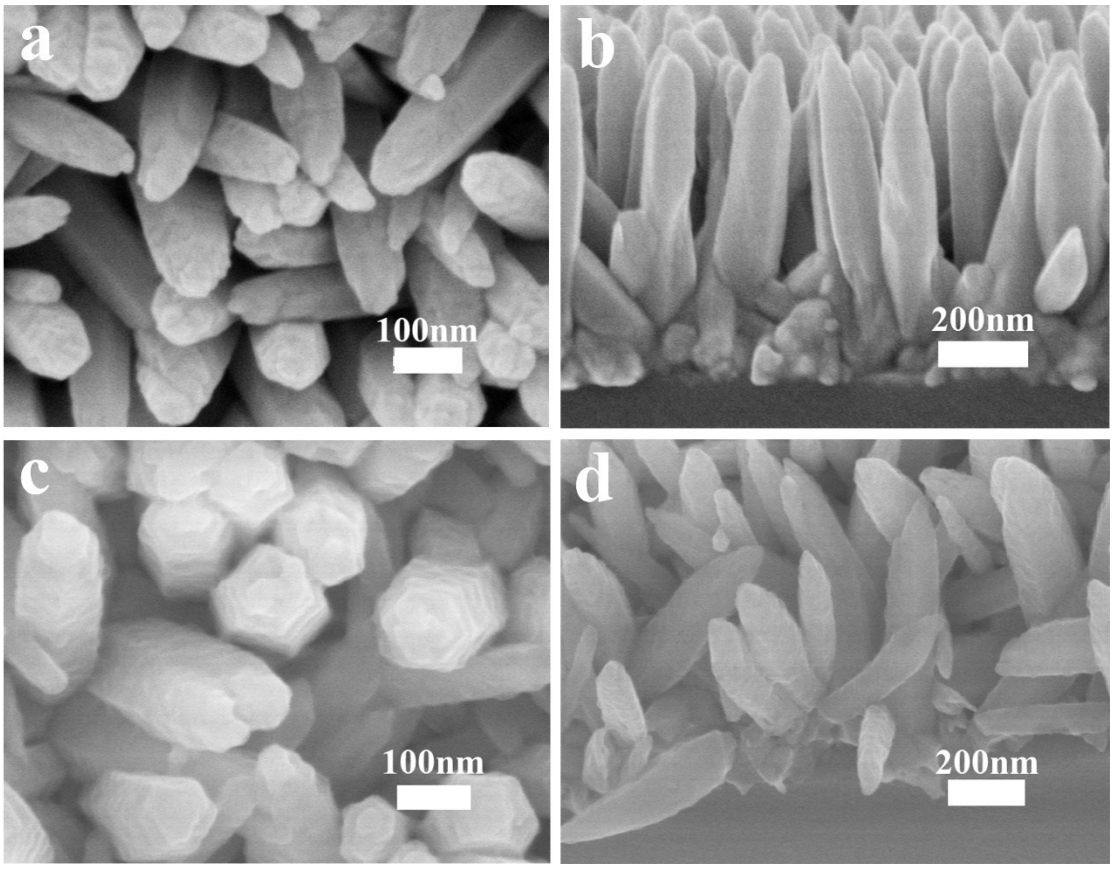

Fig. S8 Top view and cross-section view of SEM images of ZnO nanorods (reaction solution flowing through the capillary for 4 min at the rate of 25 μL•min^{-1}), (a) (b) before PAA modification, (c) (d) PAA modified ZnO nanorods.

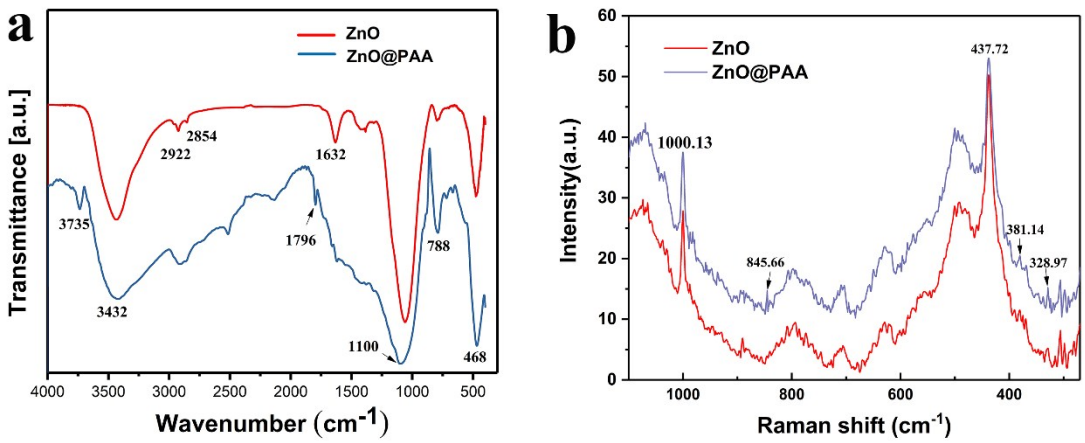

Fig. S9 Characterization of ZnO nanorods, (a) FTIR spectra of original ZnO and ZnO@PAA, (b) Raman spectrum of ZnO and ZnO@PAA. The characteristic Raman peak of ZnO is located at 437.72 cm^{-1}, which is ascribed to $E2_H$ mode of ZnO. Besides, Raman peaks located at 381.14 and 328.97 cm^{-1} can be assigned to the A1(TO) and $3E2_H$ - $E2_L$ mode of ZnO (J. Phys. Chem. C 2008, 112, 7332-7336). And the peak centered at 1000.13 cm^{-1} could be assigned to δ(COH) resulting from ethanolamine. (Carbohydrate research, 1996, 284(2): 145-157; J. Am. Chem. Soc., 1964, 86, 559–564). In the case of ZnO@PAA nanorods, the Raman peak located at 845.66 cm^{-1} corresponds to ν(C–COO) stretching, which also indicates the successful modification of PAA (Polymer, 1998, 39(2): 267-273).

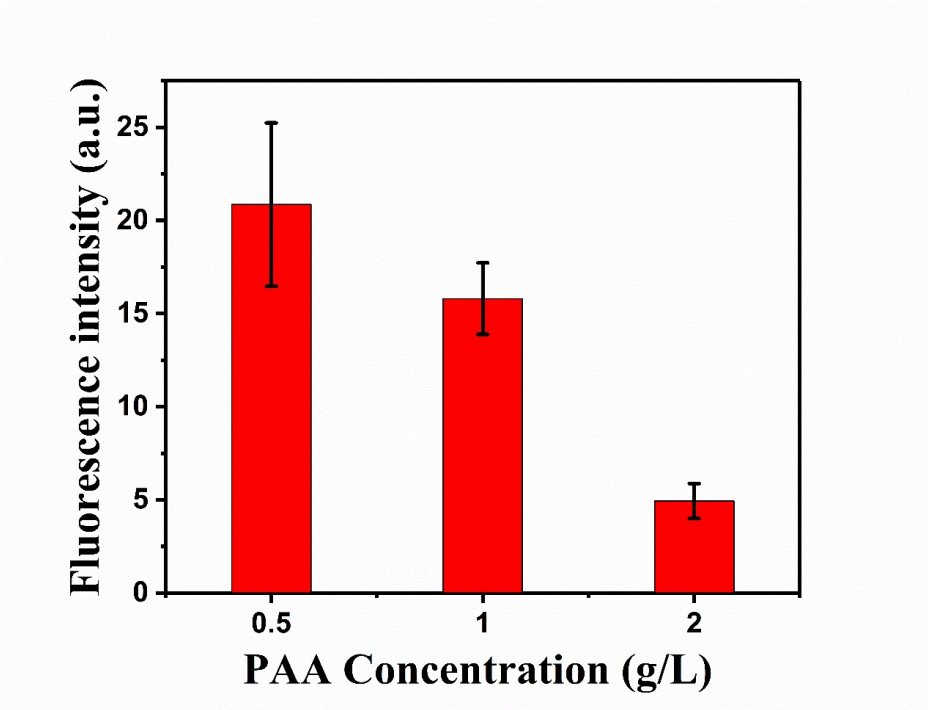

Fig. S10 Nonspecific protein adsorption on ZnO nanorod array with different contents of PAA coating.

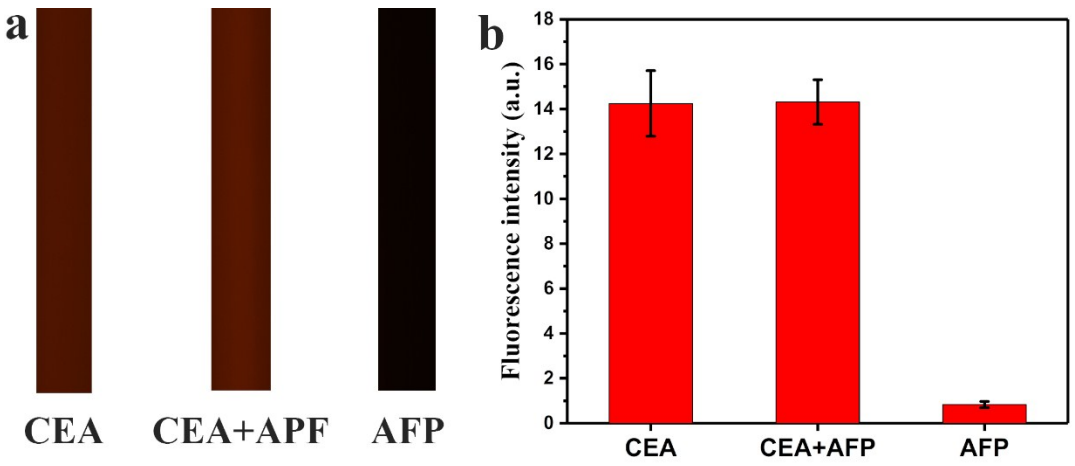

Fig. S11 Specific detection of CEA (the concentration of CEA and AFP is 1 ng•mL^{-1}). (a) Fluorescent images of CEA, CEA+AFP, AFP, respectively, (b) Corresponding fluorescent intensity of each group.