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Polyvinylpyrrolidone as A New Fluorescent Sensor for Nitrate Ion

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Polymeric materials are widely applied in many areas, such as drug delivery[1], biomedical device[2], electrochemical[3] and fluorescence sensor[4,5]. As for the fluorescence sensor, the most investigated polymeric material is the conjugated one. In this study, non-conjugated polyvinylpyrrolidone (PVP) is investigated for the first time as the potential polymeric material to sense nitrate ions by fluorescence spectroscopy. Since the toxic nitrate ions (NO_3^-) leads to environmental pollution if present in high concentration, the unsatisfied detection limit and narrow linear detection range of existing nitrate ion sensor urges researchers to develop a better nitrate sensor[3]. Therefore, a good fluorescent sensor needs to be developed to overcome this problem.

In this study, the PVP was diluted into various concentrations (3-10%) and used to sense the nitrate ions with different concentrations (10^{-4}-10^{-1} M), based on the fluorescence spectroscopy quenching. PVP showed two excitation peaks at 285 and 330 nm due to the presence of C=O and N-C, respectively. As shown in **Figure 1**, the two excitation peaks gave one strong emission at around 408 nm, which was used as the monitored wavelength for the sensing performance. It was found that the emission intensity increased proportionally with the concentration of the PVP. In order to investigate the sensing capability of the functional fluorescent groups, the quenching tests were carried out at excitation wavelength of 285 and 330 nm. At both excitation wavelengths, linear relationship was observed between the nitrate ions concentrations and the relative emission intensity. The quenching constants at excitation wavelength of 285 nm were much higher than those at 330 nm. This result indicated that C=O site was more favorable to sense NO_3^- ions than the N-C site. The PVP 7% gave the highest quenching constant; the K_{sv} value was 9.89 M^{-1} and 2.45 M^{-1} for excitation at 285 and 330 nm, respectively. The sensing capability was evaluated in the presence of interference ions (SO_4^{2-}, HCO_3^-, OH^-, and Cl^-). It was observed that the interference ions interacted strongly with the C=O, but weakly with the N-C. Therefore, in the presence of the interference ions, the PVP would be a potential fluorescent sensor when it is excited at 330 nm.

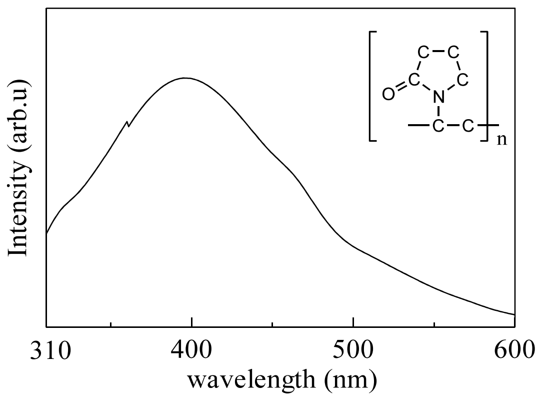

Figure 1 PVP structure with its emission spectrum which is monitored at 285 nm.

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