

# Highly Sensitive Nitrate-Sensing Materials for Ion-Selective Field-Effect Transistors for Single-Drop Rain Analysis

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Our objective is to obtain superior nitrate-sensitive materials in nitrate-sensitive membranes, which are composed of anion exchangers, systematically designed trialkylmethylammonium nitrates (TXMA-NO<sub>3</sub>) and plasticizers, which are liquid solvents, systematically designed 2-nitrophenylalkylether (NPXE) and conventional poly(vinyl chloride) (PVC) as a sensing membrane matrix. In the nitrate-sensitive membrane, a highly hydrophobic anion exchanger, such as trihexadecylmethylammonium nitrate (THDMA-NO<sub>3</sub>) improved its sensitivity, in particular, its linear response range for low concentrations, due to the decrease in elution of the corresponding nitrate from the nitrate-sensing membrane based on the plasticized PVC. However, trioctadecylmethylammonium nitrate decreased the lifetime of the nitrate-sensing membrane due to its immiscibility in the nitrate-sensitive plasticized PVC membrane. Among the plasticizers, NPXE, 2-nitrophenyltetradecylether (NPTDE) showed better miscibility in the PVC membrane and itself to be a superior plasticizer, and it also improved the lifetime of prototype checkers based on nitrate Ion-selective field-effect transistors (ISFETs) due to the better adhesion of the plasticized PVC membrane onto the gate insulator of the ISFET device. In the optimized nitrate-sensitive membrane, THDMA-NO<sub>3</sub>, NPTDE and PVC gave a good performance as the nitrate FET checker for the single-drop analysis of rainwater by direct potentiometry.

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