

Development of analytical method for detecting lower aliphatic aldehydes using β -diketone derivatives

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Formaldehyde is considered to be one of the causative agents of “sick building syndrome”, and acetaldehyde is attracting attention as a diagnostic marker for laryngeal cancer. Therefore, simple measurement of these aldehyde concentrations could lead to prevention of onset of “sick building syndrome” and early detection of laryngeal cancer. In this study, we investigated a method for detecting low-molecular-weight aliphatic aldehydes using three types of β -diketones (acetylacetone, 1,3-cyclohexanedione, and ethyl acetoacetate) [Fig. 1, 2].

The absorbance at 382 nm (1,3-cyclohexanedione) and 356 nm (ethyl acetoacetate) increased after adding acetaldehyde solution to β -diketone solutions and subsequently heating. As a result, linear relationships were obtained between the absorbance changes at 382 and 356 nm and aldehyde concentrations in the range $0\text{--}40.0 \times 10^{-6}$ and $20.0\text{--}161 \times 10^{-6}$ mol/L, respectively. The acetaldehyde solution did not react with acetylacetone solution and was most sensitive with 1,3-cyclohexanedione. The formaldehyde solution reacted with all three β -diketone solutions, and the one with the highest sensitivity was acetylacetone solution.

Additionally, we developed an analytical chip to detect acetaldehyde using porous glass impregnated with ethyl acetoacetate and evaluated its performance. Upon exposure to an acetaldehyde atmosphere, a new absorption appeared at 353 nm. The relationship with positive correlation was obtained between the absorbance changes at 353 nm and exposed acetaldehyde concentrations [Fig. 3].

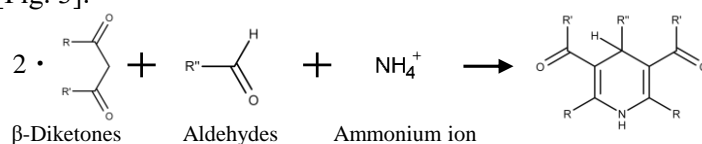


Fig. 1 Chemical reaction formula between aldehydes and β -diketones.

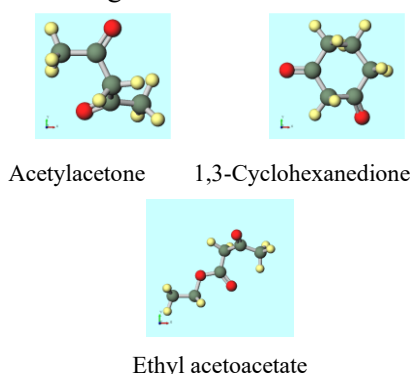


Fig. 2 Optimized structure of β -diketones.

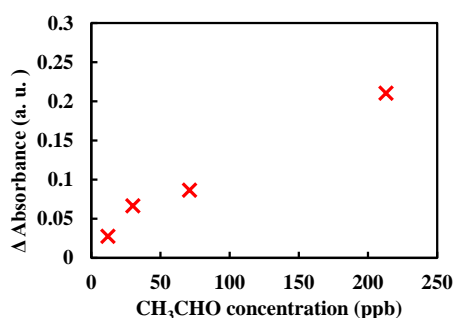


Fig. 3 Relationship between acetaldehyde concentrations and absorbance changes at 353 nm.

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