lnvestigation into Aerosol Staining for Bio-aerosol Online Monitoring

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学　位　論　文　概　要
Dissertation Summary

学位請求論文（Dissertation）
題名（Title）Investigation into Aerosol Staining for Bio-aerosol Online Monitoring
（*Japanese*）気中浮遊微生物オンライン計測のためのエアロゾル染色法に関する検討

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学位論文概要（Dissertation Summary）

Bio-aerosols, or typically, airborne microbes as fungi which are known to have potential health risks, are emitted from various sources and can be transported in long distance as those associated with dust from China. In order to discuss the contribution of emission sources and related peak health risk as well as their transportation behaviors, the real-time monitoring not only on their concentration but also on detailed characteristics is important. However, such a tool is not available in present except the UV optical particle counter (OPC), which can detect only the autofluorescence of particles. “Aerosol staining” of airborne microbes based on fluorescence staining techniques can be a tool providing such information in combination with detection technologies as flow-cytometry and UV OPC. In the present study, the mixing of aerosol microbes and mist of a fluorescence dye solution was discussed as a possible and the simplest method applicable for the aerosol staining process. As the first step, the time dependency of microbe staining also in second order, which is important to avoid difficulties caused by a long retention time of mixed aerosol, was discussed for the staining of yeast (*S. cerevisiae*) by aqueous dye solutions, or, DNA staining florescence dye, or, DAPI (4',6-diamidino-2-phenylindole) and Auramine O, a nonspecific fluorescence dye by using a spectrofluorometry. Next, the staining of yeast aerosol by mixing with the mist of 2-different florescence solutions of DAPI and Auramine O was experimentally investigated. Through the first investigation on the time dependency of dye staining, DAPI solution was confirmed to stain 50 % of yeast less than 5 seconds after mixing at a dye concentration above 1 μg ml^{-1} while Auramine O could stain yeasts in the order of second. This result refers to that the aerosol staining by mixing of yeast aerosol and mist of conventional dye solution should work if the operational condition could be adjusted, properly. In the second investigation on the aerosol staining experiment taking into account ideal conditions obtained by the first investigation, the stained fraction of yeast by mist of 2-different dyes was evaluated using two different methods 1) spectrofluorometric analysis of a liquid sample of mixed aerosol collected by a liquid impinger and 2) light scattering analysis of autofluorescence of stained aerosol particles by a commercial viable particle counter. From both experiments, even by the aerosol staining using the simple mixing of yeast aerosol and dye mist, a fraction of yeast was confirmed to be stained, indicating the staining efficiency can be improved by applying other possible method as the electrical charging of dye particles and microbes to have more efficient contacts between them. The present study could be the first step of a new methodology that could be called as “Aerosol staining” providing not only a benefit for bio-aerosol online monitoring but also various possibilities to detect characteristics of aerosol particles on line.