

Study on Organic Modified Sol-gels as Matrix for Enzyme Immobilization

Hong Dinh Duong^{2,3}, Ok-Jae Sohn^{2,3}, T. Hung Lam^{2,3}, Jong Il Rhee^{1,2,3}

Chonnam National University, ¹Faculty of Applied Chemical Engineering, ²Bioprocess Technology lab.,

³Center for BioPhotonics, Gwangju, Republic of Korea

Tel: +82 62 530 0847 Fax: +82-62-530-0846

Abstract

Sol-gel technology has been established in various fields of science and technology due to its excellent optical property, high chemical inertness and its mechanical stability. Its applications range from anti-glare, anti-scratch, optical coating to chemical catalyst carrier and MEMS.¹⁾ Organically modified sol-gels have also found many applications in biotechnology since it can be synthesized under very mild conditions. They can be easily formed by precursors such as alkoxy silane which undergo a condensation process in the presence of trace of water. These advantages make them an ideal material for immobilization of living cells and sensitive biomolecules. In this work different organically modified alkoxy silanes (methyl-tri-ethoxy-silane (MTEOS), 1-amino-propyl-trimethoxy-silane (APT MOS), 3-glycidoxypropyl-tri-methoxy-silane (GPT MOS), 3-glycidoxypropyl-di-methoxy-di-methyl-silane (GPD MOS) were employed to form thin polymer films on the bottom of the microtiter plate wells which serve as a matrix for enzymes. As the model enzyme glucose oxidase (GOD) was chosen. The activity of the immobilized enzymes was investigated by employing the photometrical APTS assay. The sol-gel ethanol solutions contained 10 to 30 V % of precursor and 2 V % hydrochloride or sodium hydroxide as catalyst. A mixture of MTEOS with GPT MOS (GM), and APT MOS with GPT MOS (GA) or GPD MOS (GD) showed the most stable polymer film resisting mechanical distortures and high acid and base concentration. Furthermore, as a general trend the acid catalyzed sol-gels were found to be a better matrix for enzymes than the base catalyzed gels: The activity of the enzymes immobilized on the acid catalyzed sol-gel matrices were about twice as high as their base catalyzed counterparts. Among the different gels the mixture GA showed the best performance in terms of longtime stability, activity, chemical and mechanical stability. Moreover, preparation of thin films with GA is easier than with the others. Furthermore, higher concentration of GPT MOS was found to increase the enzyme immobilization rate.

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