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Effect of Surface Pretreatment on Electron Transfer of Methylene Blue Covalently Labeled Double-Stranded DNA Self-Assembled Monolayers on Gold

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In this article we investigated the effect of surface pretreatment procedures on electron transfer of methylene blue (MB) covalently labeled double-stranded DNA (ds-DNA)/mercaptohexanol (MCH) mixed self-assembled monolayers (SAMs) on gold by cyclic voltammetry (*CV*) and chronocoulometry (*CC*). The pretreatment procedures included *M+E*, *M + C (piranha)*, *M + C (dilute aqua regia)*, *M + C + E (piranha)*, *M + C + E (dilute aqua regia)* and *RM + C + E (piranha)*. The *M* was mechanical polishing, *C* was piranha or dilute aqua regia dipping, *E* was electrochemical polishing and *RM* was roughly mechanical polishing. Results indicated electron transfer reaction of MB was mainly adsorption controlled. The electron transfer rate (k_s) values of MB labeled ds-DNA/MCH mixed SAMs on gold pretreated by *M+C(piranha)* and *M+C(dilute aqua regia)* were 0.84 ± 0.15 and 0.82 ± 0.17 s^{-1}, smaller than those (2.76 ± 0.28, 4.76 ± 2.68, 3.89 ± 2.06, 2.26 ~ 7.79 s^{-1}) by *M+E*, *M+C+E(piranha)*, *M+C+E(dilute aqua regia)* and *RM+C+E(piranha)* respectively. Thus, electrochemical polishing was an important pretreatment step, which might influence the k_s of MB. Furthermore, the k_s values of MB did not change monotonically with increasing gold surface roughness R_f, indicating that R_f was not the key factor to make the difference of k_s. We considered that the difference of elemental composition on gold surface possibly led to different k_s of MB. These conclusions provided the important reference for electrochemically studying DNA electron transfer mechanism.

Keywords: pretreatment procedures, methylene blue covalently labeled DNA, self-assembled monolayers, electron transfer rate, gold roughness

FULL TEXT