Novel Urea and Highly Sensitive L-Cysteine Sensors Fabricated by Combining Urease Adsorbed Gold Nets with Ammonia Electrodes

Shunichi Uchiyama* and Naoyuki Sekioka

Department of Materials Science and Engineering, Graduate School of Engineering, Saitama Institute of Technology, 1690 Fusaiji, Okabe Saitama 369-0293 Japan

(Received July 1, 2004; accepted November 11, 2004)

Key words: urease, urea electrode, potentiometry, denaturation

Urease adsorbs to metal surfaces such as gold, silver or copper in partly inhibited states. The activities of urease-adsorbed metals are highly dependent on the type of metal, and it has been found that urease-adsorbed gold has a much higher activity than urease-adsorbed silver or copper. Therefore, a novel urea electrode could be fabricated by combining a urease-adsorbed gold net and an ammonia electrode. The sensor response of urea was strongly influenced by the electrode potential applied to the gold net during urease adsorption, and was also significantly influenced by the concentration of L-cysteine in the urease solution used for adsorption. The activity of adsorbed urease increased as the concentration of L-cysteine decreased, and the calibration curve for L-cysteine showed a linear relationship down to a concentration as low as 10^{-12} M. In this study, we also measured the activities of urease adsorbed to other metal nets, and the activity of urease adsorbed to a silver net was much lower than that adsorbed to a gold net. The low activity of urease adsorbed to a silver net was dramatically recovered by the addition of dithiothreithol to the urea solution, however, the urease adsorbed to a copper net was still inactive even after dithiothreithol addition and was not recovered for 10 h of observation. The reason why the activity of urease adsorbed to silver and copper nets is low is that the conformation of urease is destroyed because the adsorptive forces of these metals are stronger than those of gold.

*Corresponding author, e-mail address: uchiyama@sit.ac.jp