29p-PB8-6

Sealed Microwells: A Potential Route to Low Noise Bio-sensors

NTT Basic Res. Labs.[1], Suzuka Nat. Coll. Tech.[2], Ruaridh Forbes[1],○ Yoshiaki Kashimura[1], Yukihiro Tamba[2], Keiichi Torimitsu[1], Koji Sumitomo[1]
E-mail: kashimura.yoshiaki@lab.ntt.co.jp

The combination of lipid bilayers and semiconductor nanotechnology holds potential for a new generation of high throughput and highly sensitive bio-sensors [1,2]. The use of sealed mircowelled structures with lipid bilayer provides a model of a cell's membrane, protiens can be incorporated into the membrane and their functional properties detected using electrophysiological techniques. A problem in trying to achieve a low-noise in environment in substrate supported bilayers is the passage of ions through the water layer between the lipid bilayer and the substrate, leakage. Here we present a device structure that makes use of self-assembled monolayer (SAM) of alkylthiol upon a Au surface to construct a multicomponent bilayer of both tethered and supported regions in order to create a seal around the microwell. The effectiveness of this modification was examined using the rate of change in the fluorescent intensity of a sodium indicator confined within the microwells.

Microwells with a thin Au ring slightly off set from the well were fabricated using conventional photolithographic and lift off techniques. Figure 1a shows SEM images of the substrate. The circular microwells have diameters of 0.5, 1, 2, 4 μm and are 1 μm in depth. A SAM of octadecanethiol (ODT) was created upon the Au ring surface, the microwells were filled with soultion of 200mM glucose containing Sodium Green 10 μM, a monovalent ion indicator for imaging and finally sealed by lipid bilayers formed by rupturing gaint unilamellar vesciles over the microwells. A schematic illustration of the fabricated structure is shown in Figure 1b alongside a fluorescence image of the bilayer covered microwell (Figure 1c). Adding 100mM NaCl to outside of a hole using non Au-ring substrates had caused significant increase to the fluorescent intensity of Sodium Green within a few minutes. In the case of the modified substrate however there was no increase in fluorescent intensity within a 30 minute time period. This device structure is expected to provided a platform by which to make very low signal to noise ratio measurement of ion channels in lipid bilayer array devices.

[1] K. Sumitomo et al., Appl. Phys. Express, 3, 107001 (2010).
[2] K. Sumitomo et al., Biosens. Bioelec., 31, 445 (2012).

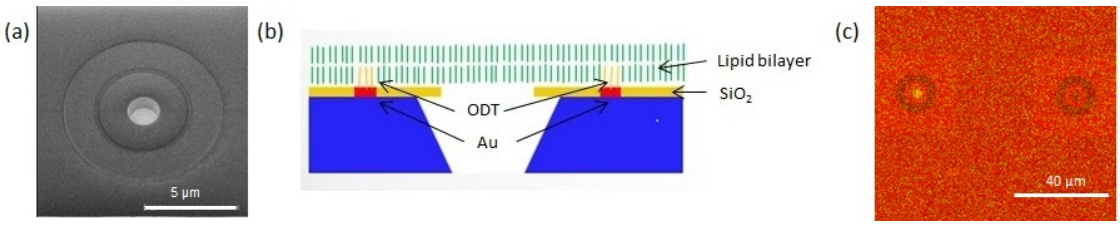

Figure 1 (a) SEM image of the Au ring substrate, (b) a schematic illustration of the modified microwell structure and (c) a fluorescence image of the bilayer (red) sealed microwell containing the fluorescent indicator Sodium Green (green)