Study on TiO_2 Photoexcitation Reaction Using Mosaic Disk Array from Ideally Order Anodic Porous Alumina

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The fabrication of nanoelectrode arrays with highly ordered disk configuration, showing enhancement of the rate of mass transport are of great interest in the area of analysis of trace amount of analytes such as reaction intermediates and products. In this study, a mosaic array of Au-TiO_2 disks was fabricated using ideally ordered anodic porous alumina (200 nm; pore period, ca. 100 nm; pore diameter)[1,2] which using the pretxturing process by the used of a SiC mold with an arrangement of convex nipple on a graphite lattice by filling periodically with Au and TiO_2, based on selective through-holing of channels in the porous alumina[3,4](Fig.1). TiO_2 disks isolated by the polymer layer in the holes of the porous alumina were surrounded by the Au nanodisk electrodes. Therefore, short-lived reaction intermediates and products formed on the TiO_2 disks by UV illumination could be detected on the Au disk electrodes which were separated from the TiO_2 disks at interval of 60 nm.

Figure 2 show the time-courses of changes in oxidation current at the Au disk electrodes with and without UV illuminations to the TiO_2 disks. Sharpe increases and decrease in the oxidation current were observed with turning UV lump on and off, indicating the detection of the reaction intermediates and products formed by photoexcitation on TiO_2. In addition, addition of superoxide dismutase which catalyzes the disproportionation of superoxide ions into the solution caused disappearance of increases in the oxidation current under UV illumination. Superoxide ions formed on the TiO_2 surface by UV illumination in neutral aqueous solutions were detected directly on the Au electrodes for the first time (Fig.3).

References

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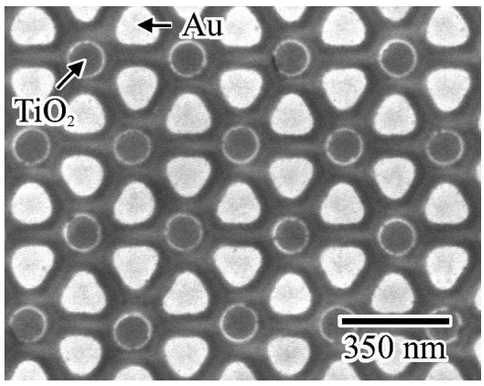

Fig.1 SEM photograph of TiO_2-Au disk mosaic array (disk interval = 60 nm)

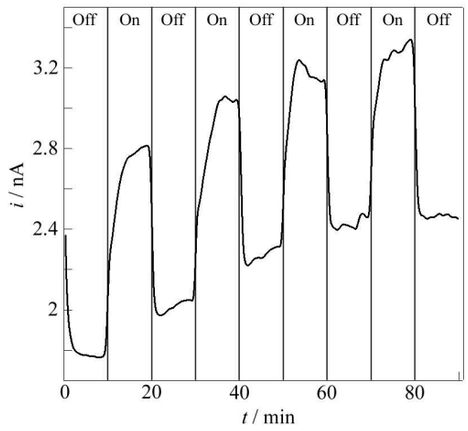

Fig.2 Typical current-time response obtained with a TiO_2-Au disk mosaic array in 0.1 M KF aqueous solution with and without of UV illumination at intervals of 10 min. The Au electrode was polarized at 0.2 V vs. Ag /AgCl (KCl sat.).

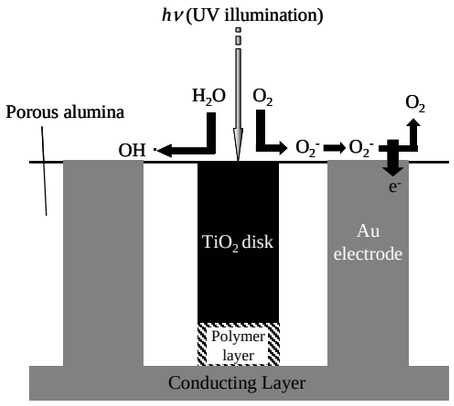

Fig.3 Schematic of electrochemical detection in photoexitation reaction on TiO_2 disks using TiO_2-Au disk mosaic array.