Light-accelerated TiO_2/Pt/Au Nanomotor Fabricated by Using Porous Aluminum Template

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Nanomotor is nanoscale devices propelled by the electrocatalytic decomposition of a chemical fuel. Such artificial nanomachines are currently the subject of intense interest due to their potential applications in nanomachinery, nanomedicine, nanoscale transport. Previously, a nanomotor was reported based on Au/Pt nanorod and propelled by electrocatalytic decomposition of the hydrogen peroxide fuel [1)] This mechanism suggests that the hydrogen peroxide reduction the anodic (catalytic) reaction on the platinum segment involves electron produces protons. And cathodic reaction on the gold segment consumes protons. Thus, electron and protons flux within, surrounding the rod toward the gold cathode (Figure 1). Because of strong affinity between protons and water, water flux is generated surrounding the nanorod from the platinum end to the gold end. So, nanomotor can propels toward platinum end. Such mechanism suggests good correlation between the mixed potential difference and the speed of bimetallic nanorod.

Motion control of nanomotor is essential for performing various tasks and diverse applications. In the present study, we newly developed a light-accelerated nanomotor based on TiO_2/Pt/Au nanorod. The nanomotor is prepared by template-directed electrodeposition within the cylindrical nanopores of a porous aluminum membrane followed by the template removal[1)].

Ag is plated within crlindrinal nanopores of a porous aluminum membrane. After that Au, Pt, TiO_2 are plated in this order[2)]. Then, the nanomotors in a porous membrane are annealed for 1 hour. Finally, TiO_2/Pt/Au nanomotors are obtained by dissolved a porous membrane in 1 M NaOH. Movement of TiO_2/Pt/Au nanomotors was conducted in 2% H_2O_2 solution under ultraviolet (UV) light irradiation.

Figure 2 shows the average speeds of the TiO_2/Pt/Au nanomotor with and without UV light irradiation. The speed of TiO_2/Pt/Au nanomotor became faster by UV light irradiation. One mechanism of Light acceleration mechanism is suggested that generation of the hydrogen peroxide fuel on the TiO_2 surface. The other mechanism is suggested that generation of radicals on the nanomotor's surface. The radicals generated were removed an impurity absorbed on the nanomotor surface. The relationship between length of TiO_2 rod and speed of the TiO_2/Pt/Au nanomotor will be shown in the conference.

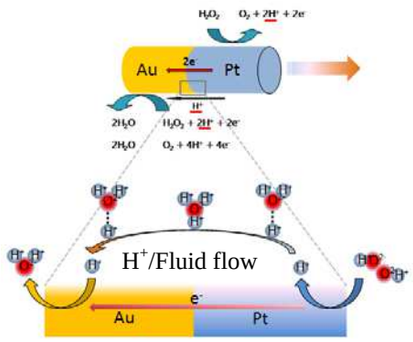

Figure 1 Driving Principle of Au/Pt nanomotor

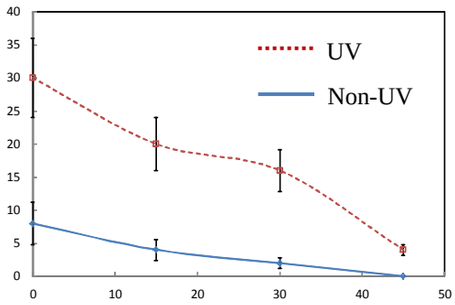

Figure 2 Speed of TiO_2/Pt/Au nanomotor with and without UV light irradiation

References
1) J. Wang, *ACS Nano*, **3** (2009).4
2) S. Karuppuchamy, et al, *Solid State Ionics*, **151** (2002). 19