IrOx(OH)y Nanoparticles for Visible Light Water Oxidation

Yong Tae Yoon, Yong Chul Kang and Yeong Il Kim*

Department of Chemistry, Pukyong National University, Busan 608-737, KOREA
(ykim@pknu.ac.kr)

The very stable $IrO_x(OH)_y$ colloidal solutions were synthesized by the hydrolysis of aqueous $IrCl_6^{2-}$ at various temperatures and times without any stabilizer or template. The synthesized $IrO_x(OH)_y$ nanoparticles in the colloidal solution have about 2 nm of diameter regardless of the synthetic temperatures of 60, 90 and 200 °C. The isolated $IrO_x(OH)_y$ nanoparticles by the acidification were all almost amorphous and the XPS data of the nanoparticles showed that the oxidation states of Ir in the nanoparticles were somehow different depending on the synthetic temperature. The nanoparticles were crystalized to the tetragonal structure of IrO_2 when they were annealed above ca. 400 °C. The crystallization temperature increased interestingly as the synthetic temperature decreased.

The catalytic activities of the synthesized colloidal solutions for photochemical oxygen evolution in $Ru(bpy)_3^{2+}$-persulfate system were strongly dependent on the synthetic temperature and time. The highest catalytic activity was obtained with the colloidal solution that was prepared at the lowest temperature and shortest time. In the optimized condition, the initial oxygen evolving rate was as high as 300 μmol/h and the turnover number for Ru-complex reached 400, which is the best ever reported in this $Ru(bpy)_3^{2+}$-persulfate system. This colloidal nanoparticle is thought to be close to iridium hydroxide rather than iridium oxide that has been known to be active species for water oxidation.

References

1. Morris , N. D.; Suzuki, M.; Mallouk , T. E. J. Phys. Chem. A 2004, 108, 9115.
2. Hoertz, P. G.; Kim, Y. I.; Youngblood, W. J.; Mallouk, T. E. J. Phys. Chem. B 2007, 111, 6845
3. Youngblood , W. J.; Lee , S.-H. A.; Maeda K.; Mallouk, T. E. Acc. Chem. Res. 2009, 42, 1966

