酸化タングステンナノ粒子の化学合成と局所構造解析

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Chemical Synthesis and Local Structure Analysis of Tungsten Oxide Nanoparticles ([1]*School of Materials Science, JAIST,* [2]*Faculty of Human Life and Environment, Nara Women's University*) ○Yuki Kitazaki,[1] Mari Takahashi,[1] Masafumi Harada,[2] Shinya Maenosono[1]

Tungsten oxide (WO_{3-x}) is used in various applications including catalysts, solar cells, and electrochromic materials.[1)] The various properties in these applications are greatly influenced by the crystal structure of WO_{3-x} and oxidation state of W. In this study, WO_{3-x} nanoparticles were synthesized in organic solvent using different types of precursors and capping ligands in order to control the morphology and the crystal structure. Their structures were analyzed using transmission electron microscopy (TEM), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), and X-ray absorption fine structure (XAFS). Fig. 1a shows a TEM image of as-synthesized WO_{3-x} nanoparticles when ammonium metatungstate hydrate was used as a precursor and both oleylamine and oleic acid were used as capping ligands. The rod-shapes WO_{3-x} nanoparticles with a long axis of about 20.8 ± 3.8 nm and a short axis of 1.9 ± 0.4 nm were obtained. From the XRD pattern of the WO_{3-x} nanoparticles (Fig. 1b), it was found that the nanoparticles contained orthorhombic phases of W_3O_8 and W_8O_{21}. Figure 1c shows the radial distribution function of the nanoparticles and the nearest neighbor distance between W and O was determined to be 1.4 Å in agreement with those of W_3O_8 and W_8O_{21}.

Keywords : Tungsten Oxide; Nanoparticles; X-ray Absorption Fine Structure; Local Structure

酸化タングステン（WO_{3-x}）は触媒、太陽電池、エレクトロクロミック材料など様々な分野で利用されている[1)]。これらの用途における種々の特性は WO_{3-x} の結晶構造や W の価数に大きく影響される。本研究では、有機溶媒中で異なる金属前駆体及び表面修飾剤を用いて化学合成した種々の WO_{3-x} ナノ粒子について、TEM、XRD、XPS、XAFS などの分析手法を用いて構造解析を行った。図 1 にメタタングステン酸アンモニウム水和物を前駆体とし、オレイルアミン及びオレイン酸を表面修飾剤として合成した WO_{3-x} ナノ粒子の TEM 像、XRD パターン及び動径分布関数を示す。WO_{3-x} ナノ粒子の形状はロッド状で、W_3O_8 と W_8O_{21} の 2 種の斜方晶相が混在していると考えられる。XAFS スペクトルから、W と O の最近接原子間距離を求めたところ、1.4 Å であり、理論値と一致していることが明らかとなった。

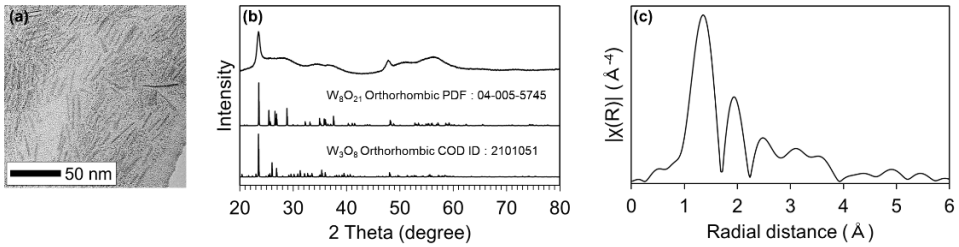

Figure 1. (a) TEM image, (b) XRD pattern and (c) Radial distribution function of WO_{3-x} nanoparticles.

1) H. Zheng *et al*., *Adv. Funct. Mater*. **2011**, *21*, 2175.