β-MoO_3 nanowhiskers in the development of $^{99}Mo/^{99m}Tc$ medical radioisotope preparation using a hot atom mechanism

Ngo Minh Chu*, Nguyen Duy Hieu, Thi Mai Dung Do, Tadachika Nakayama, Koichi Niihara,

and Hisayuki Suematsu

Extreme Energy-Density Research Institute, Nagaoka University of Technology, Nagaoka, Niigata 940-2188, Japan

*E-mail: ngominhchu@stn.nagaokaut.ac.jp

Abstract:

In the production of Tc-99m (radiopharmaceuticals), the neutron activation (n,γ) method using MoO_3 pellet is considered to have more benefits than the nuclear fission products (n,f) method [1]. However, the low specific activity of ^{99}Mo has barred large scale manufacture. Currently, as the ^{99}Mo extraction process in the (n,γ) method, high-density pellets of MoO_3 after the irradiating are considered diluted in NaOH solution [2]. Therefore, it consumes time and has difficulties in separating and recovering compounds. Instead of this process, a hydrous MoO_3 target has been proposed to overcome these problems and promise to increase the effectiveness of the (n,γ) method using a hot atom mechanism of irradiated samples. This target requires a porous structure with a suitable filtering property. Whisker is a suitable candidate with excellent filtered property. Among MoO_3 phases, β-MoO_3 is the best catalyst caused by its crystal structure with a larger space among valent binding of Mo and O than the other phases [3]. Therefore, it is a good condition for water can go through and wash the hot atom from the irradiated target. β-MoO_3 nanowhiskers were only synthesized by pulsed wire discharge, in which the purity was low [4]. In this research, a β-MoO_3 nanowhisker with a width of 10 nm was synthesized by thermal evaporation method with the oxygen gas flow at 750, 800, 850, 900, and 1000 ºC. The samples were characterized and confirmed by XRD in Fig. 1 and lattice image by FE-TEM in Fig. 2. From this work, the high content and purity of β-MoO_3 nanowhiskers were synthesized by the thermal evaporation method. This sample is a promising material for the irradiation target in the (n, γ) method.

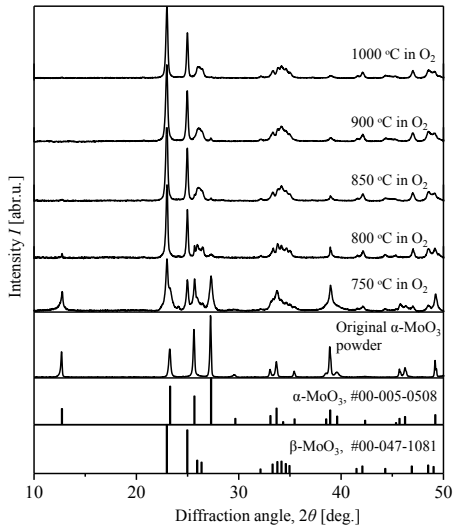

Fig.1. XRD results at different heating temperatures

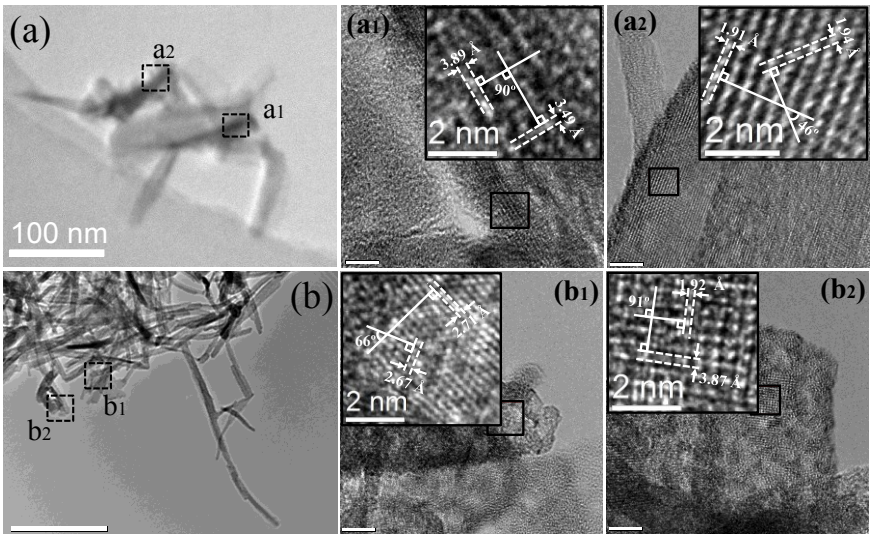

Fig.2. TEM images and lattice images with analysis results of whiskers at areas of (a) and (b)

References:

1. JAEA-review 2012-030. In: E. Ishitsuka, M. Ishihara, M. Suzuki, eds. Proceedings of the specialist meeting on Mo-99 production by (n, γ) method. Japan, Tokyo: JAEA.2012:1-14.
2. Nishikata K, Kimura A, Ishida T, Tsuchiya K, Shiina T, Ohta A, et al. Japan; 2014. Contract No.: JAEA-Technology--2014-034.
3. Svensson G, Kihlborg L. A molybdenum oxide with a WO_3-type structure obtained by oxidation of (orthorhombic) Mo_4O_{11}. Reactivity of Solids. 1987;3(1):33-43.
4. Chu NM, et al., International Journal of Applied Ceramic Technology. 2020; in press.