# Oxidization of Molybdenum Nanoparticles in Mixed Gases at a Constant Oxygen Partial Pressure by Pulsed Wire Discharge

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Molybdenum is a transition metal with a very high melting point and very low thermal expansion.[1] Mo and its compounds have many applications in coatings, electronic devices, optical devices, and being used for radioactive application in the synthesis of $^{99}$Mo from $MoO_3$ to fabricate technetium (Tc).[2,3] To study deeply about this material, MoC has been synthesized successfully by using pulsed wire discharge (PWD) method in mixture gases of argon and kerosene.[4] In this research, with the purpose of understanding how Mo oxides are formed in PWD. Some experiments have been carried out, where Mo wire of 0.25 mm in diameter with 25 mm in length was used. The experiments were implemented in oxygen partial pressure of 25 kPa, and different total pressures were applied by adding nitrogen gas; the charged voltage for the capacitors of PWD was constant, 6 kV. X-ray diffraction (XRD) measurements were used to identify phases in the samples and shown in Fig. 1. The different results were observed by changing total pressure. With only 25 kPa of oxygen gas, entire Mo was oxidized completely. However, when keeping the same partial pressure of $O_2$ and increasing total pressure by adding $N_2$, the Mo volume fraction increased. To observe the samples, field emission scanning electron microscopy (FE-SEM) was used, and particle size distribution was calculated in each condition by FE-SEM images. The results are shown in Fig. 2. From the voltage and current waveforms, the formation of β- and α-$MoO_3$ phases have been explained by the cooling speed of Mo vapor/plasma.

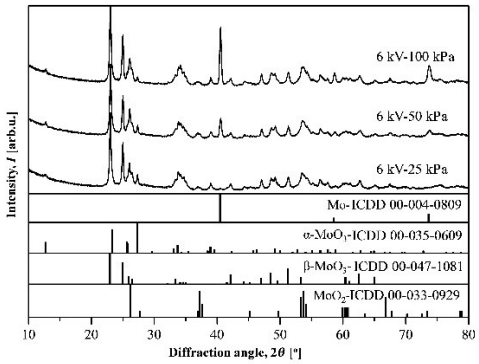


Fig. 1 XRD measurement result

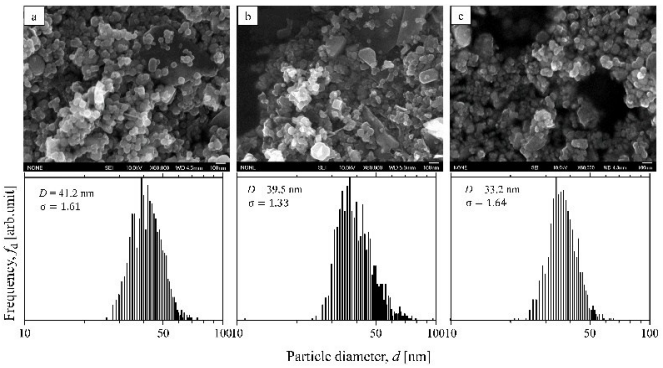


Fig. 2. FE-SEM images (upper panels) and particle distributions (lower panels) of nanoparticles prepared at pressures of (a) 100, (b) 50, and (c) 25 kPa.

References

1. http://www.chemistryexplained.com/elements/LP/Molybdenum.html
2. https://avantama.com/moo3-applications-molybdenum-trioxide-nanoparticles
3. A. P. Ilyin, et al: Phys Procedia. 2015; 72: 548-551.
4. N.M. Chu, N.D. Hieu, D.T.M. Do, R. Sarathi, T. Nakayama and H. Suematsu: J. Am. Ceram. Soc; in press.