

21st COE Seminar Series #8
Department of Materials Engineering
The University of Tokyo

**Nano-powder of Transition Metals Produced
through Homogeneous Reduction**

by

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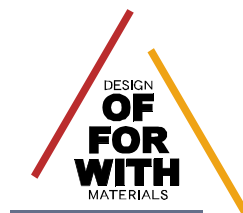
Reducing particle size to the range of nano-meters scale (<100 nm) will bring new and unique property to the materials. Those nano-materials are highly focused in developing new devices. An example of nano-powder application is nano-capacitor: reduction in particle size from the current value of around 0.5 μ m to something nearer 10 nm would significantly improve the performance of capacitors. However, the current technology of powder producing by thermoreduction in molten salt is beyond the possibility of nano-particle production. Two facts in the molten salts thermoreduction limit the particle size of the product powder: 1) high processing temperature results in an undesirably high rate of particle growth; 2) the reductant (sodium in the case of tantalum production) is immiscible in the molten salt diluent promotes heterogeneous nucleation of product metal. Therefore the ideal condition for nano-particle production through a chemical reactions involving precipitation would be a homogeneous reaction. For the case of a reduction reaction this requires a common solvent which can both dissolve feed salt and reductant. From the perspective of establishing favorable conditions for making ultrafine powder, metal-ammonia solutions possess ideal electrical properties and are stable at subambient temperatures (low temperatures enhance nucleation and restrain growth). This method of producing nano-particles of transition metals was performed in reducing tantalum and niobium salts and nano-powders of average particles size around 20 nm were obtained. The method was also extended to produce nano-powder of intermetallic compound by one-step reduction directly. In this presentation, the theory and experimental results will be discussed, and the unique route for producing nano-particles will be described in detail.

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