ULVAC

Arc Plasma Deposition System

APD-P series

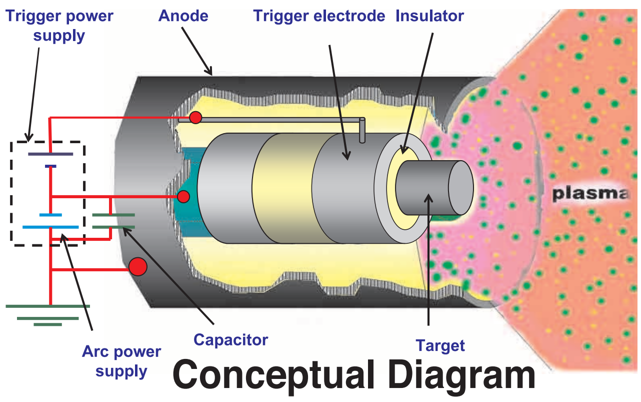
Newly developed coaxial vacuum arc deposition system, APD-P, can form extremely smooth ultra thin films or well size-controlled nano-particles, owing to metal plasma of target material generated by pulsed vacuum arc discharge.

■ Features and Applications

- New nano-particle formation system by a dry process
- Well-size and size-distribution controllability of nano-particles by changing vacuum arc discharge parameters
- Less coagulating and sintering properties of obtained nano particles even under the high temperature environment
- Low temperature and UHV clean process
- Alloy or compound nano-particle available by use of two guns or reactive arc discharge process
- Simple pulsed vacuum arc process without any cooling water and process gases
- Small target size of ϕ10mm ×L17mm

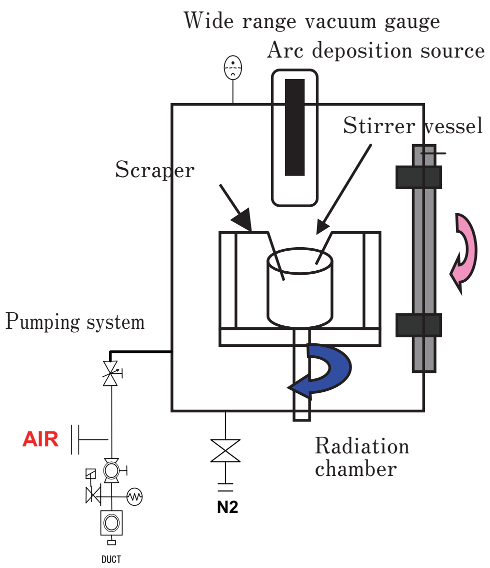
■ Discharge mechanism

The schematic of newly developed coaxial pulsed vacuum arc discharge system is shown in the figure. After chamber evacuation, a trigger induces an arc discharge on the surface of target rod. Then highly ionized metal plasma is generated from the target rod without any discharge gases, and deposits on the substrate to form various thin films and nano-particles. The film thickness can be controlled by the number of pulses of the arc discharge. Typical deposition rate of the film is 0.1nm/shot.

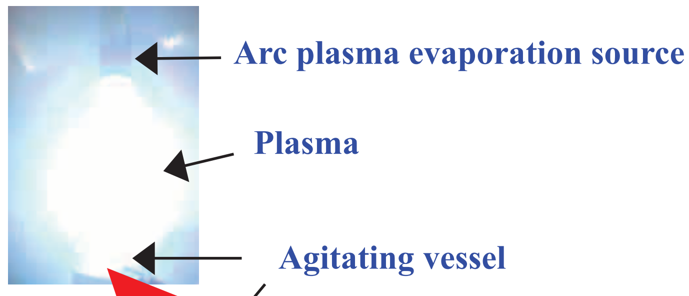


Conceptual Diagram

■ System diagrm



■ Powder supported with nano particles



Options
1. Gas injection line for nitrogen or oxygen: Maximum 2 lines
2. Additional arc plasma deposition source: Maximum 2 units

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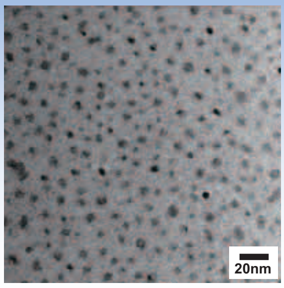
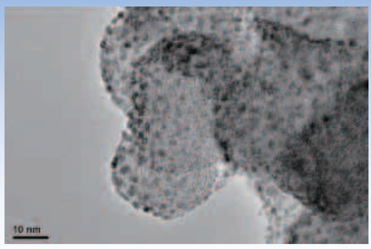
Examples for sample

Metal nano-particles on substrate:



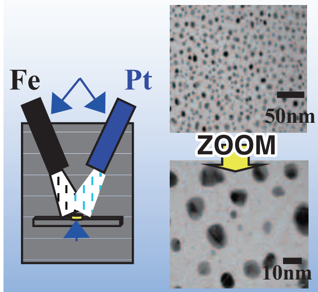
TEM image of cobalt nano-particles on a micro grid. These uniform cobalt nano particles ranging from4 to 5 nm in diameter are deposited by 10 pulse discharge using APD system.

Platinum nano- particles on carbon powder:



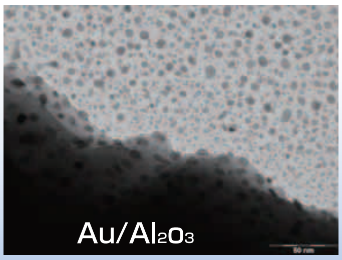
By the use of APG, platinum nano particles were deposited on carbon powder stirred under vacuum. Platinum nano-particles with diameter of 2 to 3 nm, are uniformly dispersed and supported on carbon powder.

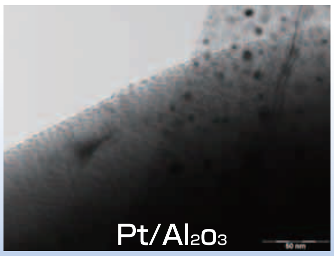
Formation of nano particles of platinum and iron alloy with 2 guns:



Nano-particles of platinum and iron alloy are synthesized on a micro grid using 2 guns with a platinum and an iron simultaneously. Two different sizes of nano-particles are mixed: 2 and 10 nm in diameter. Energy dispersive X-ray spectrometer (EDX) detected the signals of platinum and iron from each particle, showing alloy nano-particles are formed.

Metal nano-particles on oxide powder:





Because nano-particles by the use of APG can be physically adsorbed on a substrate, related evaporation particles could be deposited on any kinds of substrates. By evaporating a metal target under reduced oxygen atmosphere, oxide nano -particles could be deposited on some oxide power.

Elements checked for deposition

Deposition-confirmedcompounds

WC,TiAl,SiC,NiFe,inconel, TIN,Al_2O_3,TiO_2,SiO_2,HfOx, AlN,HfC,MoS_2

Checked
Limited in use

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Li	Be											B	C	N
Na	Mg											Al	Si	P
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi
Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Ds					

Specifications

Chamber size	: 400 mm wide ×400 mm long × 300 mm high
Pumping system	: Turbomolecular pump unit (450 L/s)
Vessel size	: Inner volume 80 mm in diameter, 50 mm high, made of Teflon, SUS vessel is optional.
Powder charging capacity	: 5 to 10 cc
Stirring speed	: 1 to 10rpm
Deposition rate	: 0.01 to 0.3nm/s (1 pulse/s, target-to-substrate distance 80 mm)
Film thickness uniformity	: Fe<±10% (within a 20mm-dia. area, target-to-substrate distance 80 mm)
Depositing material	: Conductive material in general (Fe, Co,Ni and other metals, and carbon)
Target size	: Cylinder solid: 10 mm dia, ×17 mm long, cylinder hollow: 10 mm OD × 5.5 mm ID ×17 mm
Target life	: Approx. 30,000 pulses (*depending on target material)
Operating frequency	: 1, 2, 3,4, 5 pulses/sec

Utility Requirements

System size	: Approx. 900 mm wide × 800 mm deep × 1600 mm high
Floor space requirements	: Approx. 1600 mm wide × 1000 mm deep × 2000 mm high
Weight of the system	: Basic unit approx. 500 kg (The installation floor requires a withstand load of 500 kg/m² or more.)
Venting nitrogen	: 0.02 MPa one line
Exhaust duct	: One (the joint depends on mating)
Operating temperature	: 20 to 30℃
Power requirements	: 200 V AC, three phase, approx. 50/60 Hz, 10 kVA

· This system is made/sold under formal licensing agreement with the Japan industrial Technology Association (JITA), an extra-department of the Japanese. Ministry of Economy, Trade and Industry.
· Joint patent application [Patent application 9-230336]. Individual applications [Patent
· Publication 2004-197177] and 29 others.

Agent

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