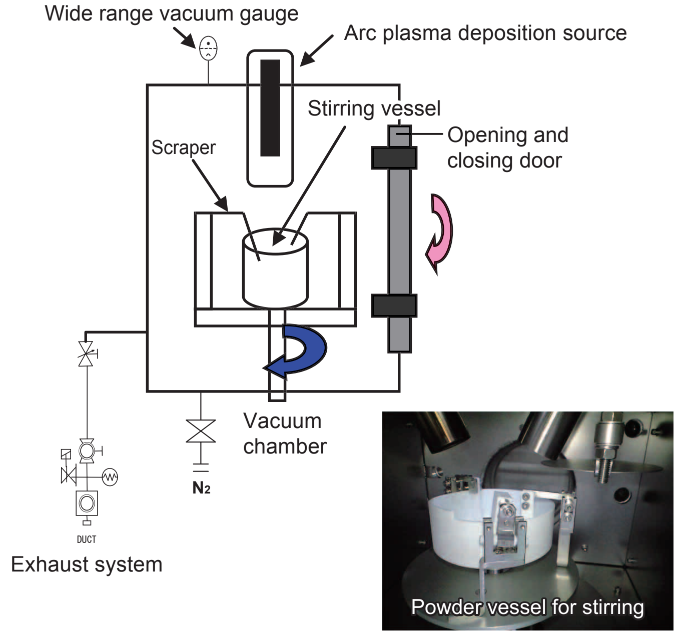
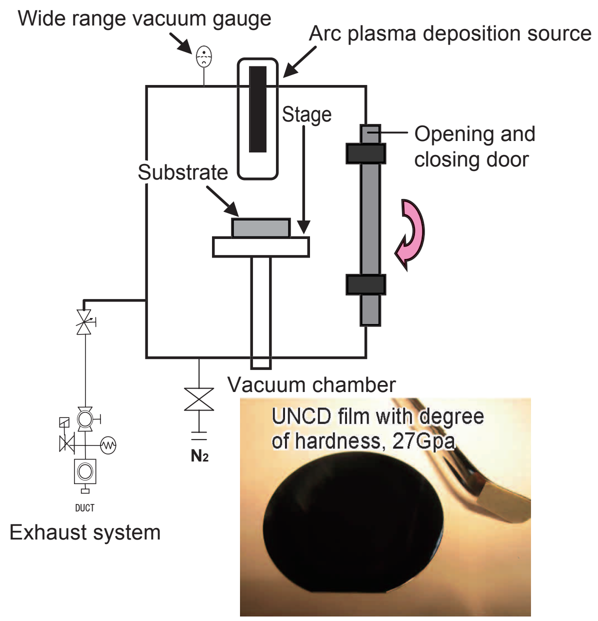
APD Series specifications

■ APD-P(support to powders model)



Powder vessel for stirring

■ APD-S(Substrate deposition model)

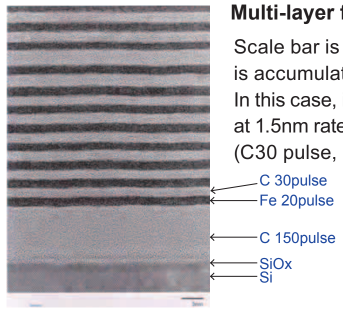


UNCD film with degree of hardness, 27Gpa

■ Common Specifications

1. Chamber size: W400mm x D400mm x H300mm
2. Exhaust system: Turbo-molecular pump unit 450L/s
3. Arc plasma source: Standard type 1 unit(3 units at the maximum)
4. Deposition atmosphere: Vacuum and Low pressure process gas(N_2, H_2, Ar and O_2)
   *Gas is optional
5. Target: Electrically-conductive materials(Φ10 x L17mm) cylinder is also acceptable.
6. Target specific resistance: 0.01 ohm cm or less
7. Condenser capacity: 360 μF x 5 pcs.(selectable)
8. Pulse rate: 1,2,3,4,5 pulse/s
9. Machine operation: Touch panel type
10. Discharge voltage: 70V to 400V(Maximum 150V at 1800μF)

Nanometer film



Multi-layer film of iron and carbon

Scale bar is 5nm, and Fe(black color) is accumulated by approx. 1.5nm.
In this case, it forms a film with 20 shots at 1.5nm rate.(approx. 0.075nm/pulse)
(C30 pulse, Fe 20 pulse, C150 pulse)

■ Support to powders model specifications(APD-P)

1. Powder vessel: Φ 95mm x H30mm(inside dimension)
   with stirring mechanism (made of Teflon or SUS)
2. Powder fill ration: 13 to 20cc(Vary by particle diameter and density)
3. Number of rotations: 1 to 50rpm

■ Substrate deposition model specifications(APD-S)

1. Substrate size: Φ2-inch(Φ50mm), non-deposition
   by 5mm from the edge of the substrate
2. Number of rotations for substrate: 1 to 10rpm
   (50rpm without heating mechanism)
3. Substrate heating: RT to 500°C(Lamp heating) optional

■ Utility

1. Space required: W900mm x D1200mm x H1600mm(not including maintenance space)
2. Weight: Aprox. 500kg
3. Power requirements: Φ3 AC200V 50/60Hz 10kVA through breaker terminal
4. Grounding requirements: Class A grounding 1 line, Class D grounding 1 line
5. Compressed air type pump: 0.7MPa or more

※Specification and appearance are subject to change without notice for performance improvement.

Agent

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Cat.No.APD_E_v1.1／16.01.0000®

ADVANCE RIKO

Arc-Plasma method nano-particle Deposition system

APD series

Nano-particles produced by arc plasma
offer you new functional materials.

Individual applications [Patent Publication 2004-197177] and 29 others.

ADVANCE RIKO, Inc.

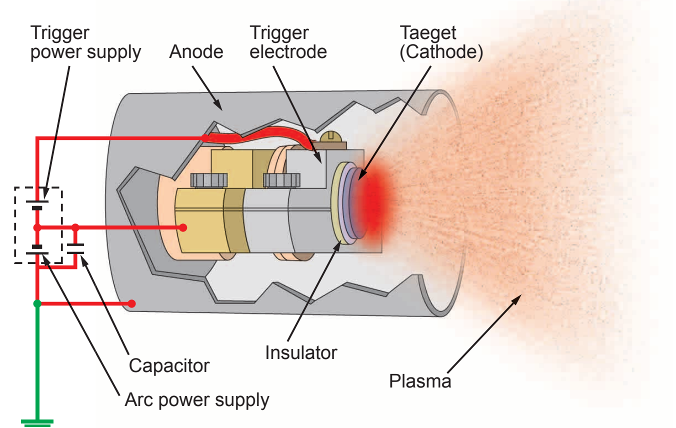
APD series Arc-Plasma method nano-particle Deposition system

Applications

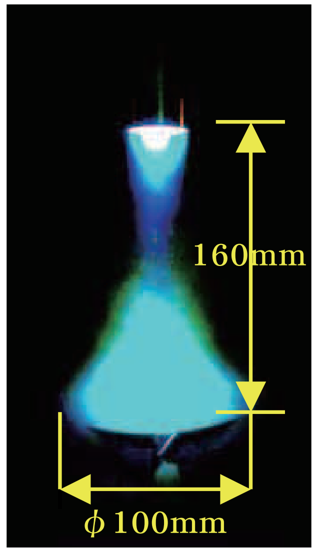
1. Supported catalytic nano-particles to electrode materials such as fuel cell
2. Research for new catalytic nano-particle materials
3. Generation of DLC(Diamond Dry Carbon)
4. Formation of nano-particles for CNT(Carbon nano-tube)
5. Generation of UNCD(Ultrananocrystalline diamond)
6. Production of thin-film thermoelectric elements using thermoelectric material target
7. Compound generation by multi target
8. Generation of oxide and nitride nano-particles(in O_2 and N_2 gas)

Mechanism

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.

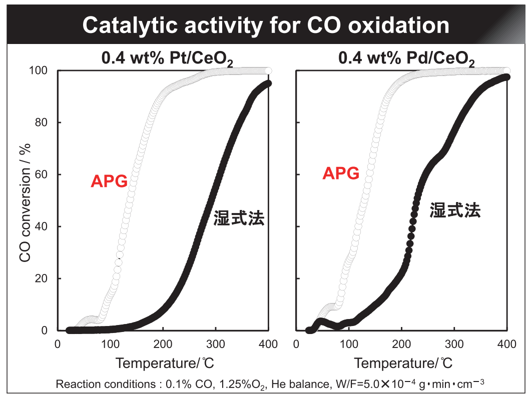


Conceptual Diagram



Five Futures

1. The system can select nano-particle diameter within the range of approx. 1.5nm to 6nm by changing condenser capacity.
2. The system can make any material plasmatic in case they are electrically-conductive materials(target).
   *Specific resistance for target is 0.01 ohm cm or less
3. The system can readily generate oxide and nitride by changing atmosphere.
   Also, when graphite is discharged in H_2 gas, it generates UNCD(Ultrananocrystalline diamond).
4. The nano-particles supported by the system shows active catalytic effects as compared with wet process.
5. Model APD-P supports nano-particles to powders.
   Model APD-S supports nano-particles to 2-inch substrate.
   *The above-mentioned 1, 3 and 4 depend on literatures.



Pt and Pd catalysts supported to CeO_2 with Arc-Plasma method show higher catalytic activity for CO oxidation as compared with catalysts with conventional wet process.
Quoted literatures: "Ministry of Education, element strategic project achievement" by Professor Machida at Kumamoto University

Relation between condenser capacity and nano-particle size

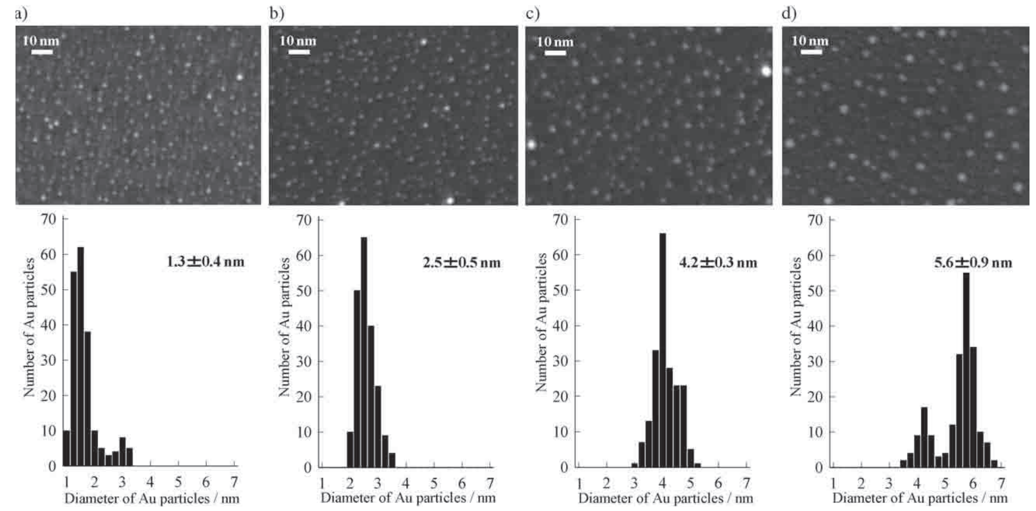
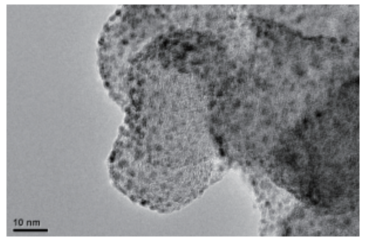


Figure 1. Field-emission SEM images (top) and the size distributions (bottom) of gold particles deposited on the $TiO_2(110)$ surfaces at various condenser capacities: a) 360, b) 720, c) 1440, and d) 2200 µF. One MLE of gold was deposited on each TiO_2 surface at an arc voltage of 70 V, at room temperature, and under 10^{-9} Torr. The numbers in the size distribution diagrams indicate mean diameters and standard deviations of gold particles.



TEM image in which the system supports Pt to carbon powders

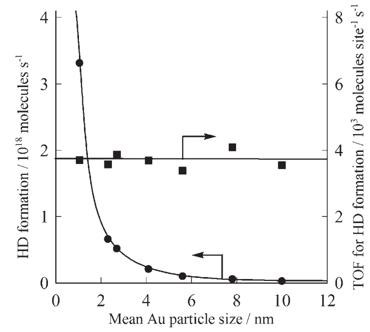


Figure 2. The rate of HD formation for each catalyst sample with the same gold loading (1 MLE) and the turnover frequencies based on the length of the perimeter interface as a function of the mean diameter of gold particles. H_2–D_2 exchange reaction was performed in batch mode using a mixture of 6 Torr H_2 and 6 Torr D_2 at 425 K.

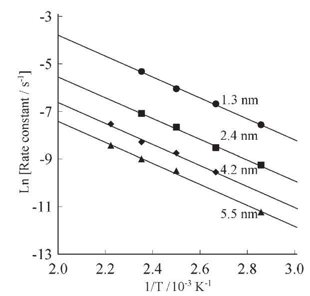
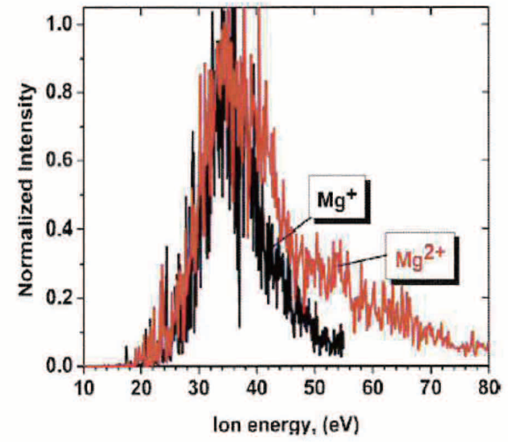
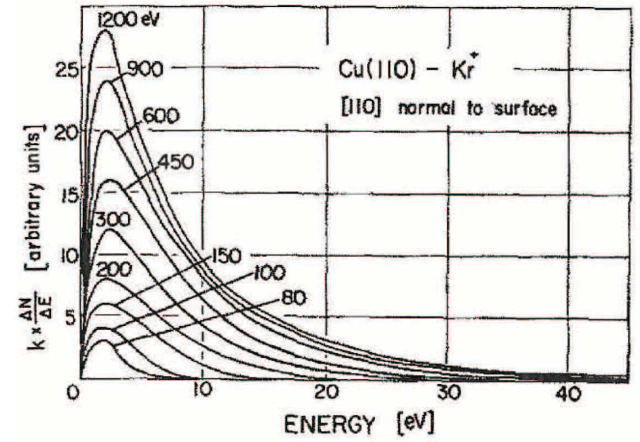


Figure 3. Arrhenius plots of the rate constants of HD formation over the 1 MLE Au/$TiO_2(110)$ surfaces having different mean diameters of gold particles. The H_2–D_2 exchange reaction was performed in batch mode using a mixture of 6 Torr H_2 and 6 Torr D_2 at 350–450 K. The rates were obtained from the slope of the tangent of the conversion–time curves in HD formation at time $t=0$. The rate constants were calculated based on the first-order reaction, which was experimentally confirmed.

Quoted literatures: Article published by Mr. Tadahiro Fujitani at Research Institute for Innovation in Sustainable Chemistry in National Institute of Advanced Industrial Science and Technology



arc-plasma method 30 to 45eV on average



sputtering method 2 to 3eV on average

The difference in energies largely contributes to the generation and function of nano-particles.
(The vertical axis is no unit of quantity required due to relative values.)

Quoted literatures: Arc-plasma J. Appl. Phys. 101(2007)043304 SputterJ. Appl. Phys. 35(1964)1819