

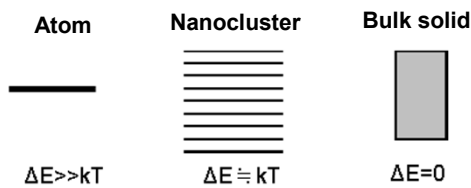
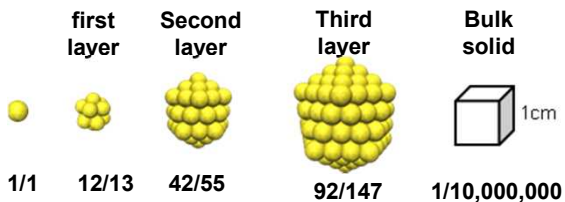


# Precisely Controlled Nanocluster Assembly

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## 1. Features of nanoclusters

Nanocluster means an assembly which consists of several to several hundred atoms or molecules.



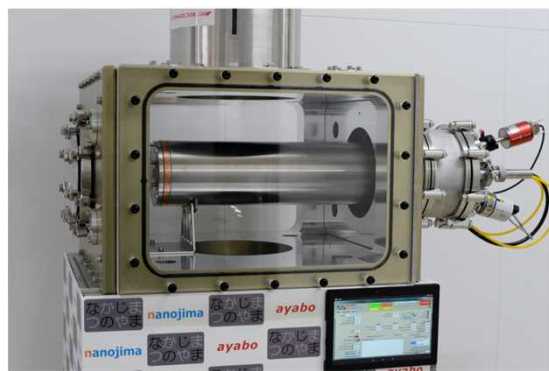
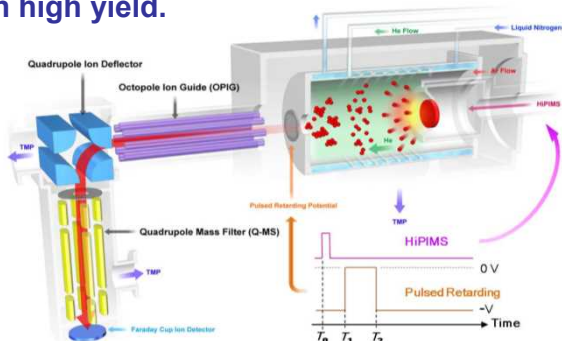
$\Delta E$ : Interval of energy levels     $kT$ : Thermal energy

■ A high surface atomic ratio.

■ As the electronic structure is discrete, a specific catalytic activity point or magnetism appears.

## 2. Preparation of Nanocluster

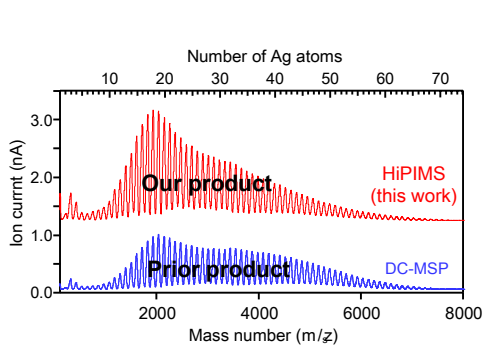
Our Nanocluster can be prepared by the method of high power impulse magnetron sputtering (HiPIMS) in high yield.



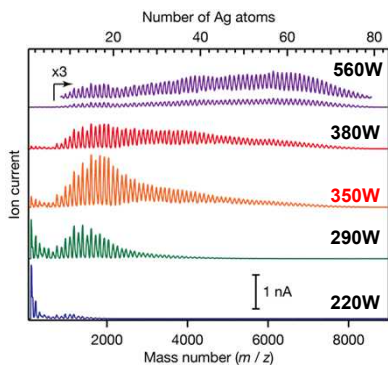
Nanocluster generator  
(Trial machine by Ayabo Corporation)

■ When the wave modulation is applied to the sputtering voltage, the duty ratio is adjusted at the same time.

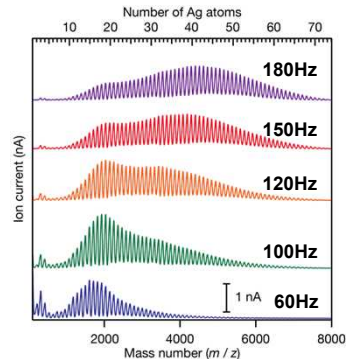
■ An electric field which has been delayed in synchronization with the sputtering voltage is added at the exit of the electrode of cluster growth chamber.



Mass spectrum of Ag nanocluster



Size control of the discharge power



Size control by the repetition frequency

By a variety of parameter settings, it is possible to synthesize the nano clusters and nano particle size for the purpose.

parameter: Pulse power, Repetition frequency, Pulse waveform, Duty ratio, Voltage blocking electric field, etc.

## 3. Superiorities to conventional technique and Advantage of our technology

- 1 nm level's nanocluster can be prepared. (2-3 orders of magnitude smaller size than conventional cluster)
- It is not limited to metal. Manufacturing of semiconductors and multi-element nanoclusters also possible.

## 4. Potential Market

- New devices in electronic or magnetic field
- High-performance catalysts

## Patent Licensing Available

Patent: PCT/JP2014/063877  
JST/ IP Licensing Group

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<http://www.jst.go.jp/tt/EN/>