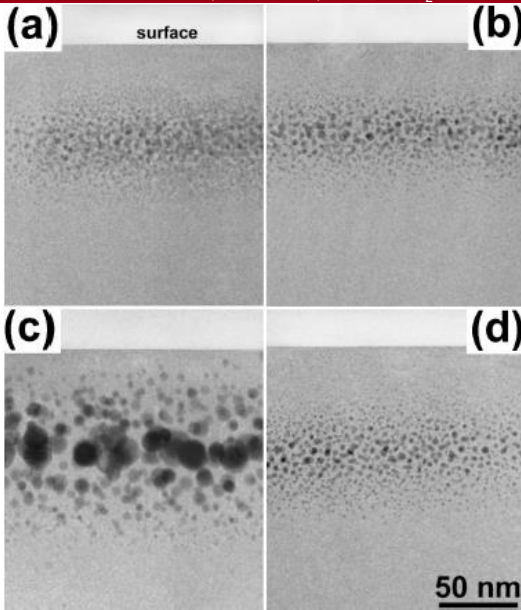


# Nucleation and Growth

(Au NCs in SiO<sub>2</sub>)

Energetics



(a) 400°C air, 1h

$\langle D \rangle = 1.6 \pm 0.8$  nm

(b) 700°C air, 1h

$\langle D \rangle = 2.1 \pm 0.9$  nm

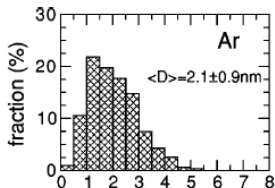
(c) 900°C air, 1h

$\langle D \rangle = 5.3 \pm 3.9$  nm

(d) 900°C Ar, 1h

$\langle D \rangle = 2.0 \pm 0.9$  nm

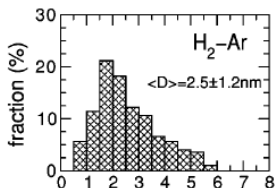
50 nm



**Ar (Inert)**

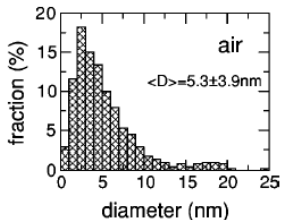
$\langle D \rangle = 2.1 \pm 0.9 \text{ nm}$

Comparison among  
thermal annealings at  
900°C 1h



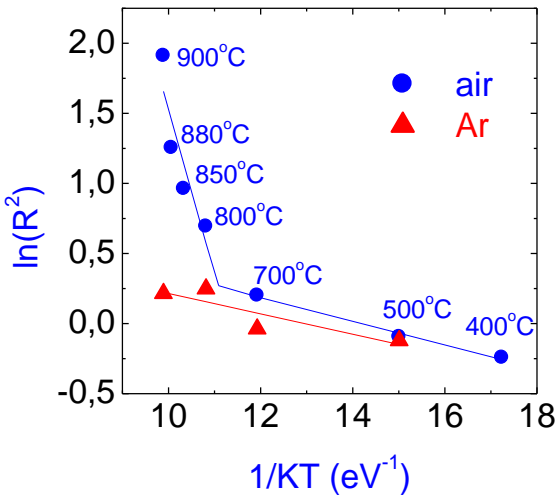
**H<sub>2</sub>(4%)-Ar (Reducing)**

$\langle D \rangle = 2.5 \pm 1.2 \text{ nm}$



**Air (Oxidizing)**

$\langle D \rangle = 5.3 \pm 3.9 \text{ nm}$



Activation energy of the process  
above 700°C ( $\Delta E_{clu} = 1.2$  eV) similar  
to the activation energy for the  
Oxygen diffusion ( $\Delta E_{O_2} = 1.1-1.3$  eV)

(Au diffusion in SiO<sub>2</sub> exhibits an  
activation energy  $\Delta E_{Au} = 2.4$  eV)

**Correlated Diffusion (Onsager)**

$$\begin{cases} \frac{\partial C_1}{\partial t} = D_{11} \frac{\partial^2 C_1}{\partial x^2} + D_{12} \frac{\partial^2 C_2}{\partial x^2} \\ \frac{\partial C_2}{\partial t} = D_{21} \frac{\partial^2 C_1}{\partial x^2} + D_{22} \frac{\partial^2 C_2}{\partial x^2} \end{cases}$$

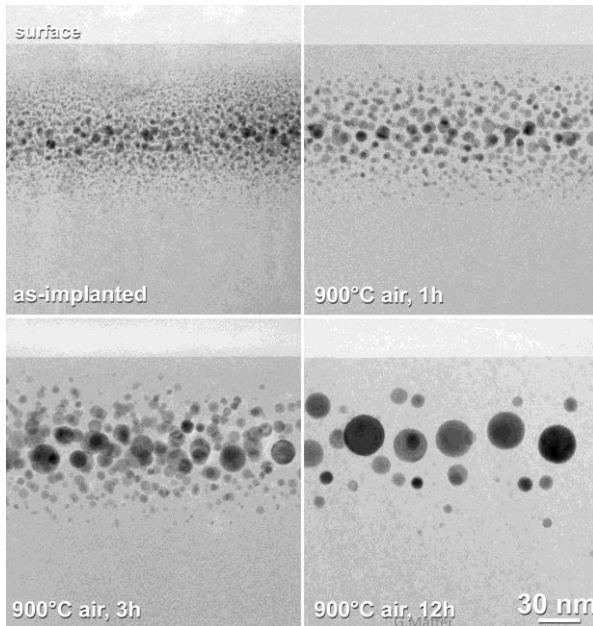
**Correlated diffusion Au-O<sub>2</sub>**

# Nucleation and Growth

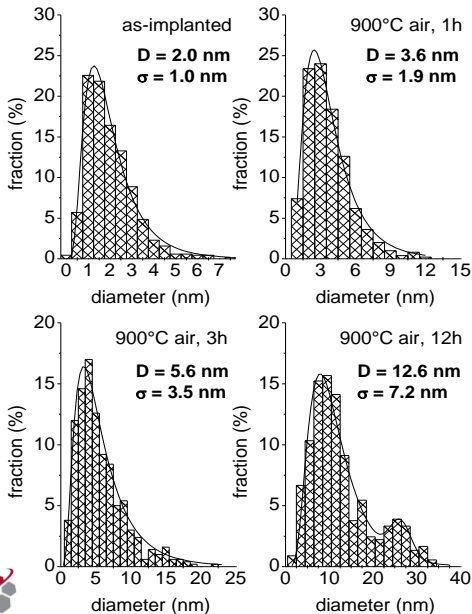
(Au NCs in SiO<sub>2</sub>)

Kinetics

Thermal annealing in air  
at 900°C vs. time



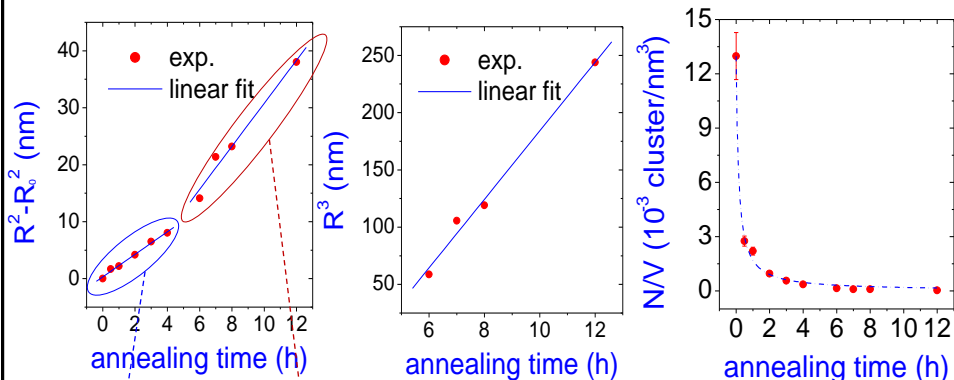
*G. De Marchi, G. Mattei, P. Mazzoldi,  
C. Sada, A. Miotello, J. Appl. Phys. 92  
(2001) 4249*



Thermal annealing in air  
at 900°C vs. time

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## Growth Kinetics (900°C)



Cluster numerical density ( $N_{clu}/V$ ) decreases as a function of the annealing time

Change in the growth rate around 4 hrs of annealing