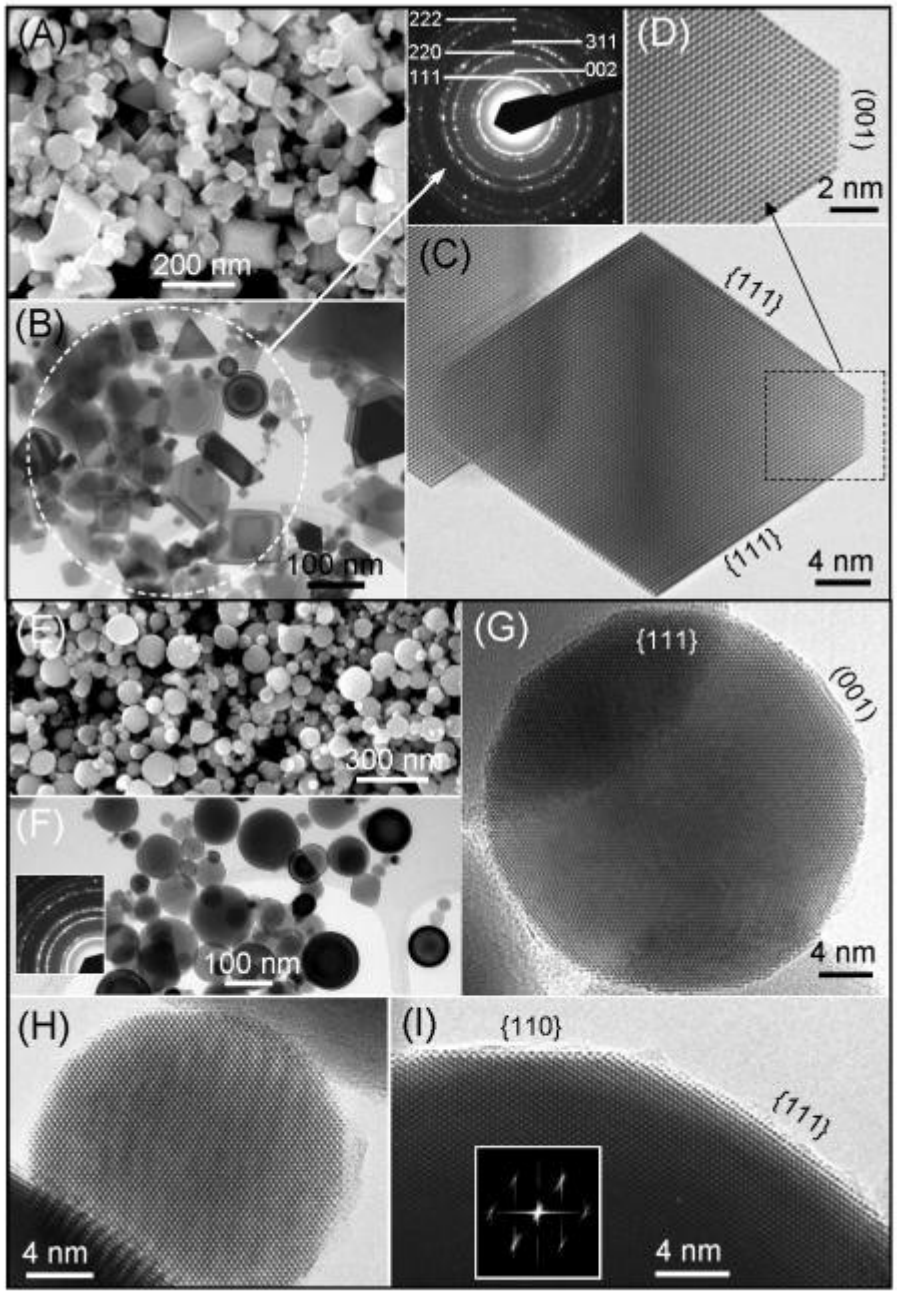
(A)
200 nm
222
220
111
311
002
(D)
(001)
2 nm
(B)
100 nm
(C)
{111}
{111}
4 nm
(E)
300 nm
(G)
{111}
(001)
(F)
100 nm
4 nm
(H)
4 nm
(I)
{110}
{111}
4 nm

Fig. 1

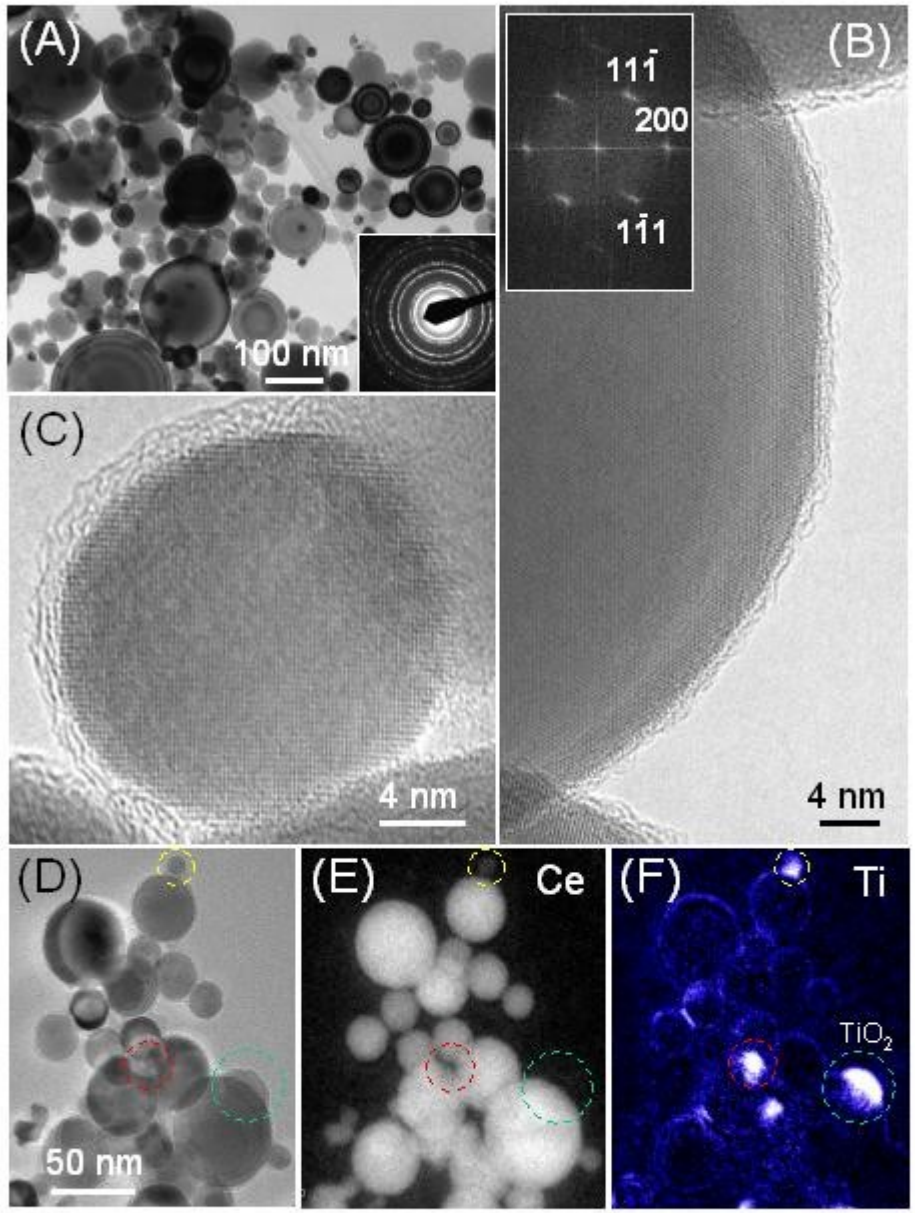

Fig. 2

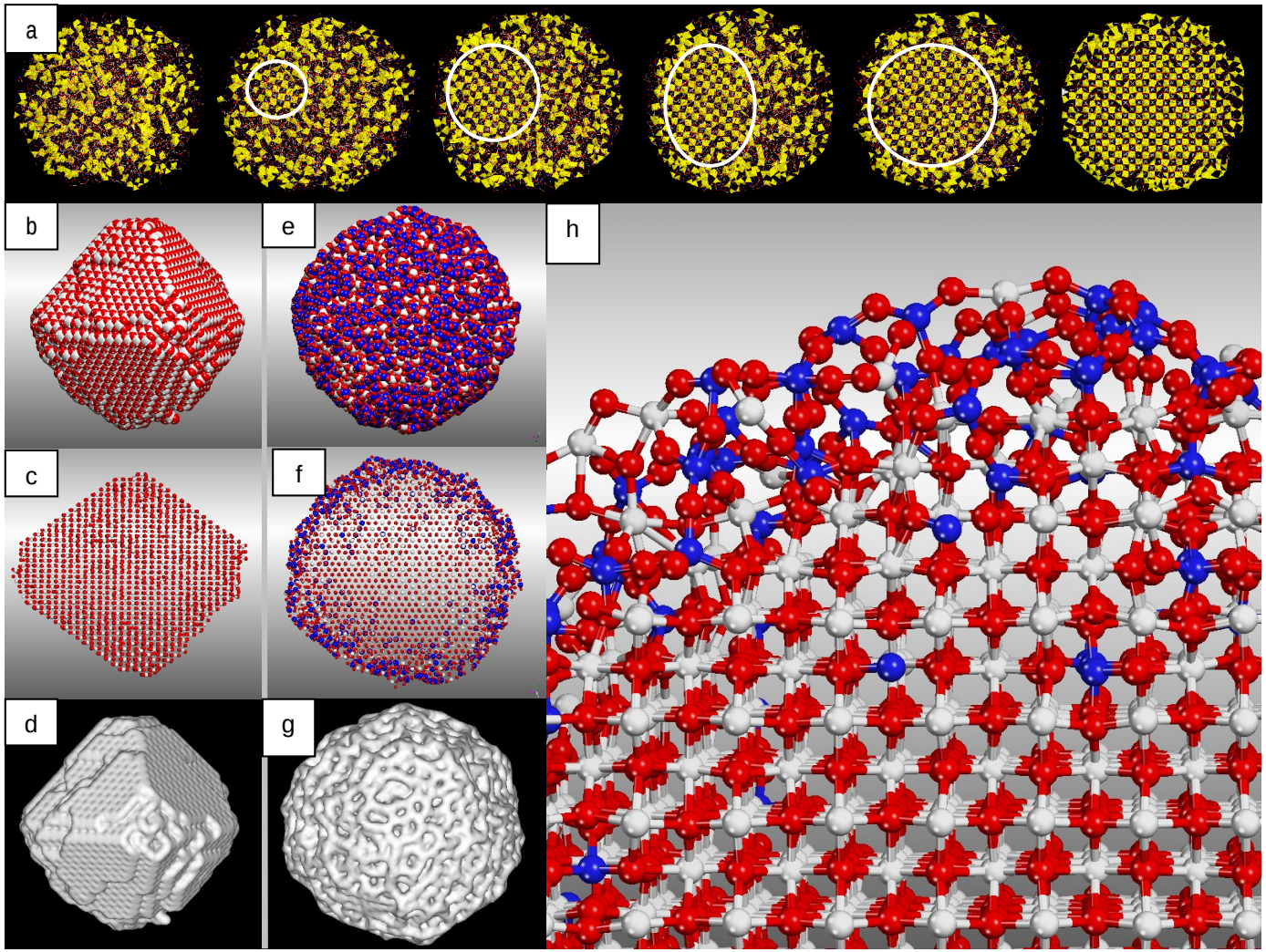

Fig.3

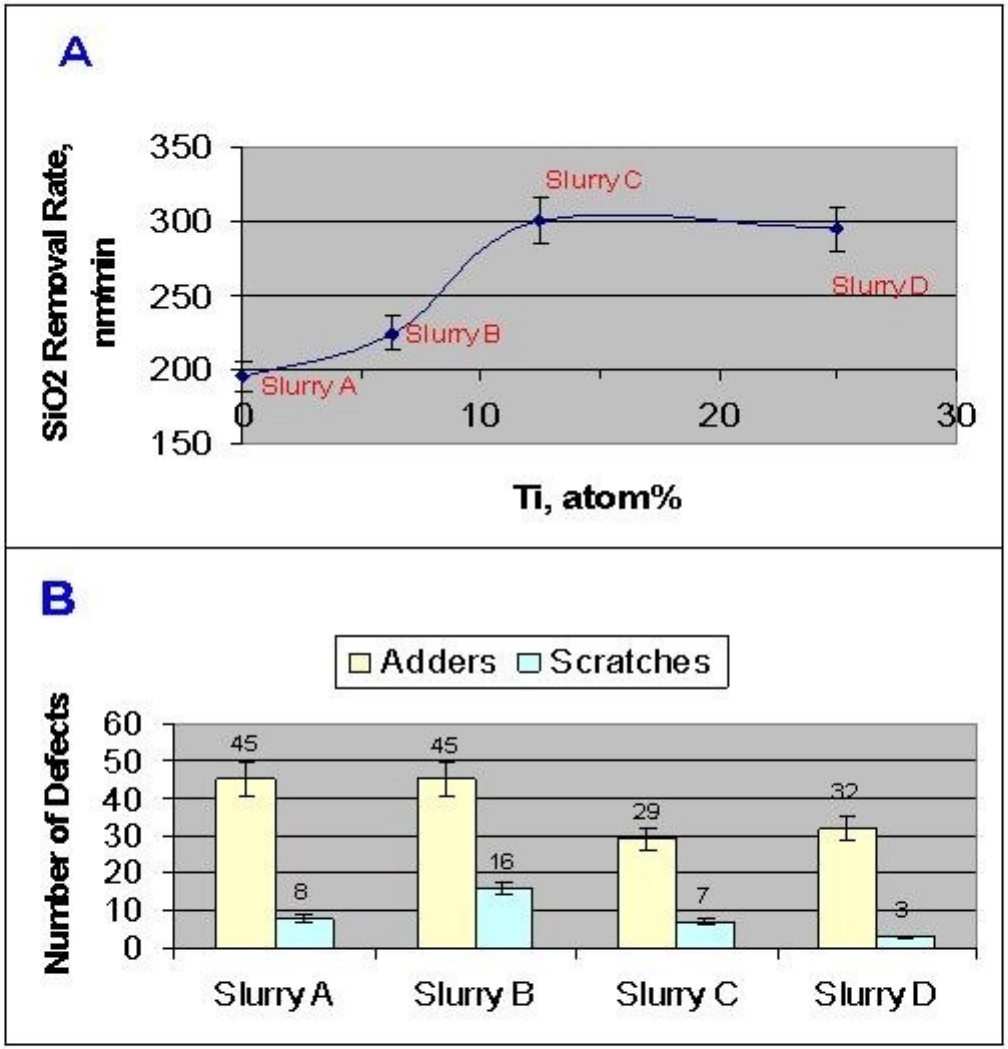
A
SiO2 Removal Rate, nm/min
350
300
250
200
150
0
10
20
30
Slurry A
Slurry B
Slurry C
Slurry D
Ti, atom%
B
Adders
Scratches
Number of Defects
60
50
40
30
20
10
0
45
8
45
16
29
7
32
3
Slurry A
Slurry B
Slurry C
Slurry D

Fig.4

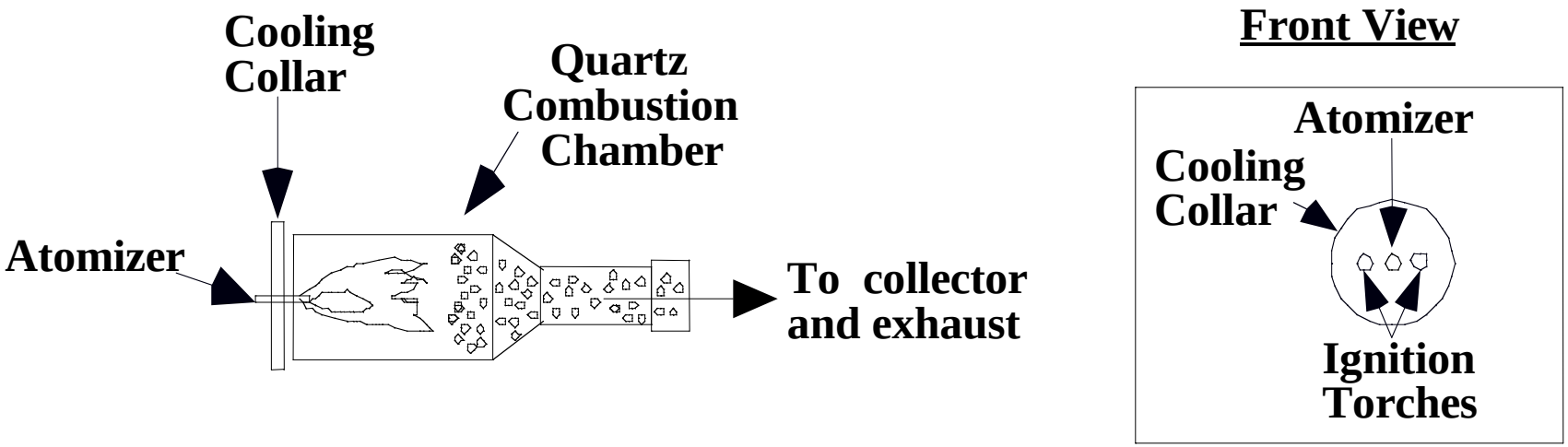

Figure S1: Schematic of a L-FSP apparatus in use at Nanocerox

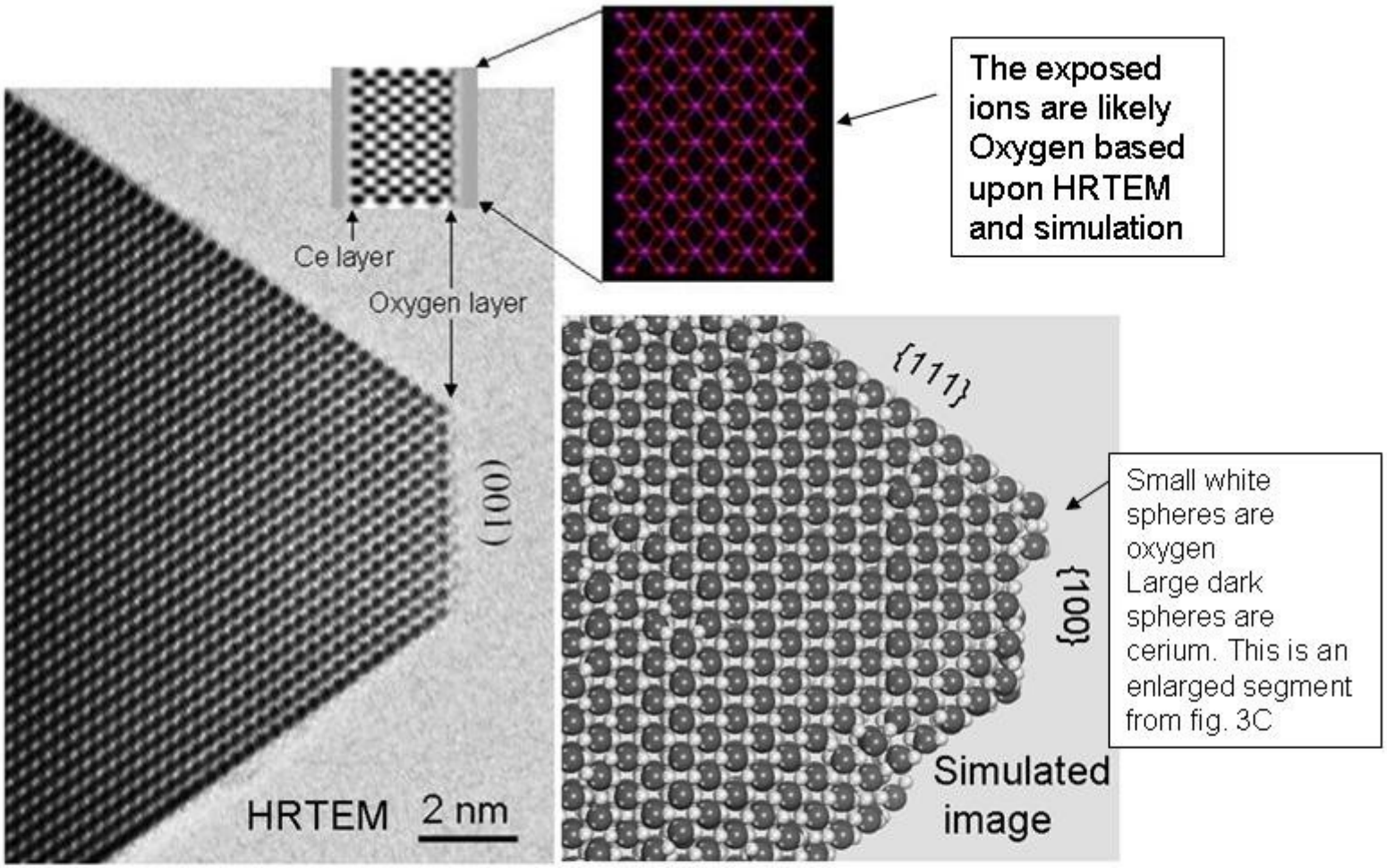

Fig. S2. High-resolution TEM image of the as-synthesized ceria Particle without Ti doping, showing octohedral shape. The simulated image at the right-hand indicates that the Surface is likely to be terminated with oxygen

Fig. S2

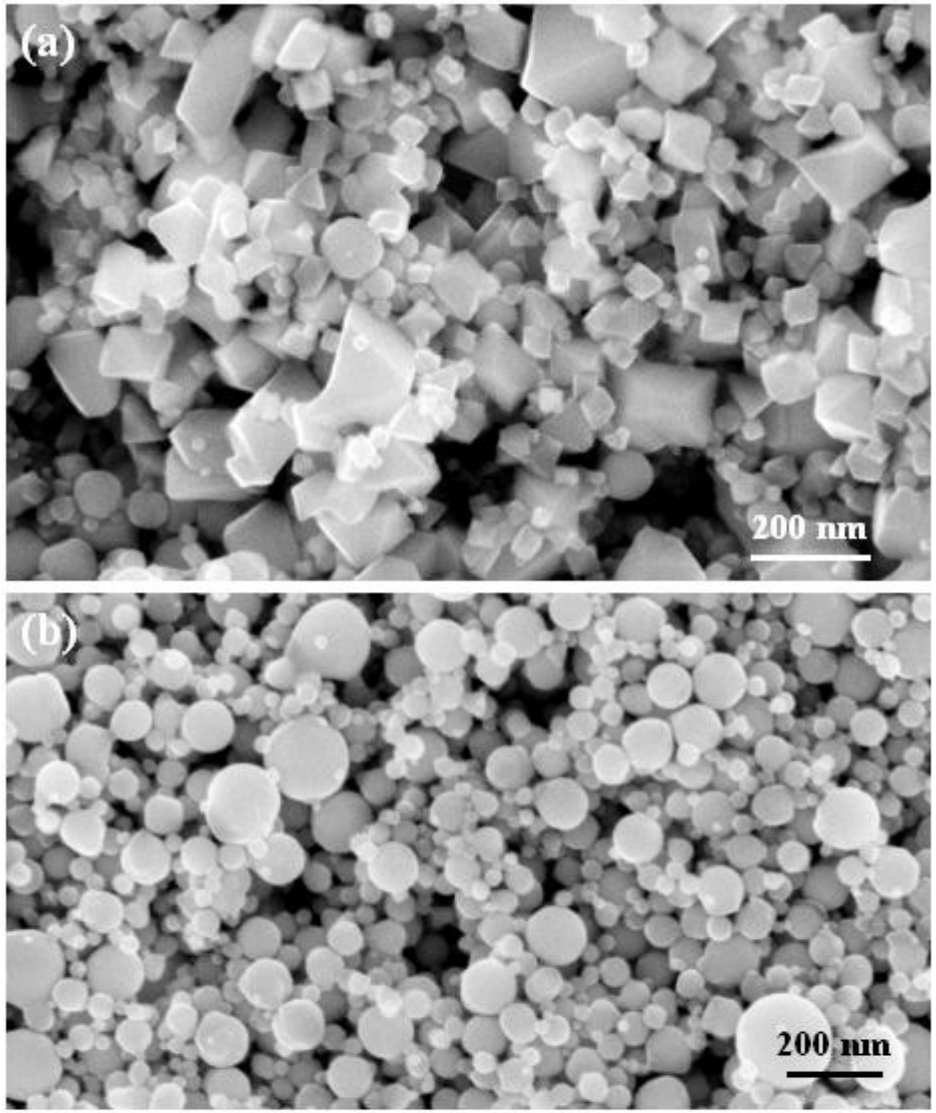

Fig. S3: SEM images of the as-synthesized ceria particle (a) without Ti doping and (b) with 6 at. % Ti doping, showing a drastic difference in particle shape.

Fig. S3

Fig.S4

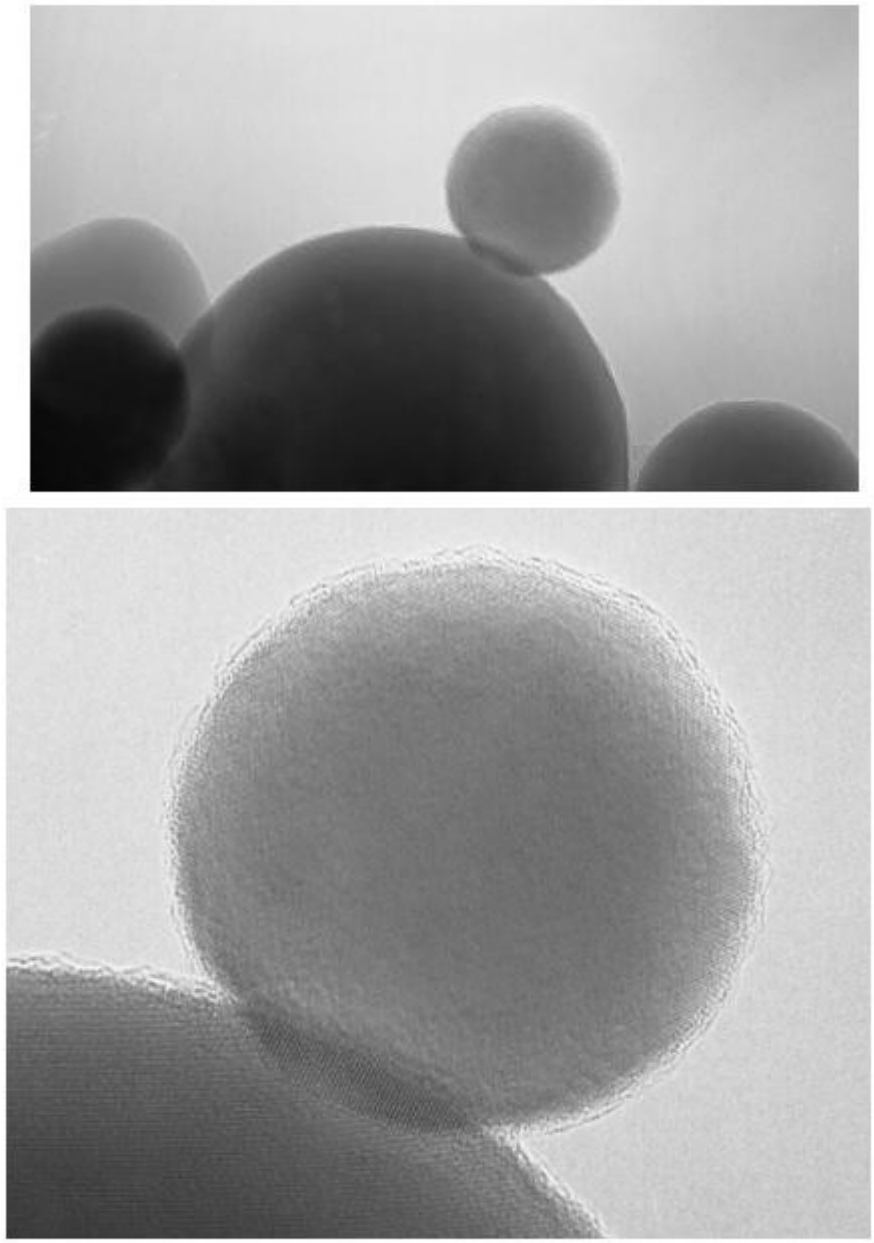

Fig. S4: TEM image of Ti doped ceria single-crystal nanoparticles with perfect spherical shape.

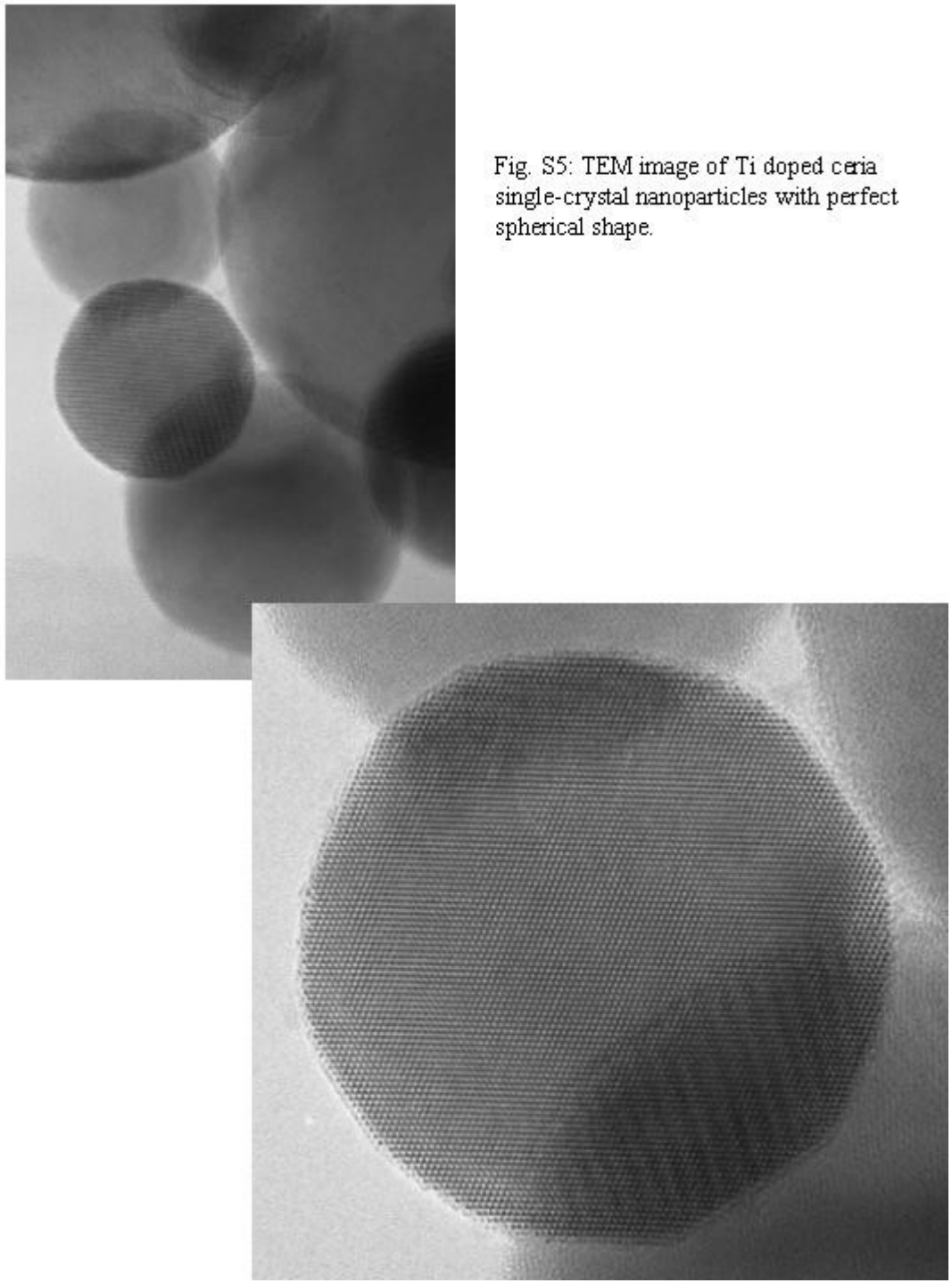

Fig. S5: TEM image of Ti doped ceria single-crystal nanoparticles with perfect spherical shape.

Fig.S5

Fig.S6

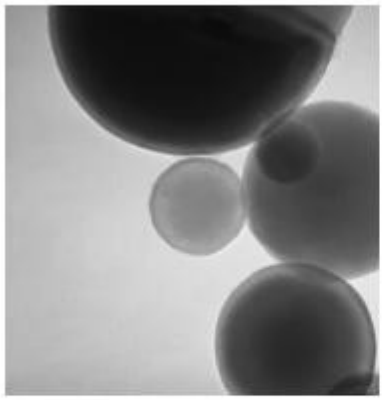

Fig. S6: TEM image of Ti doped ceria single-crystal nanoparticles with perfect spherical shape.

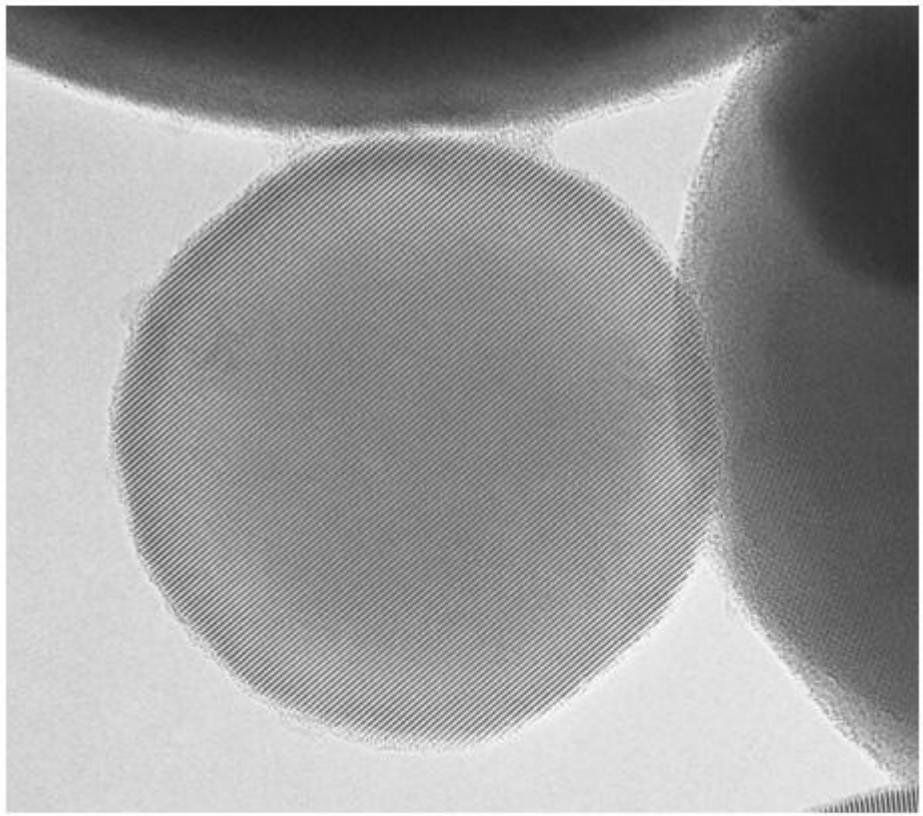

Fig.S7

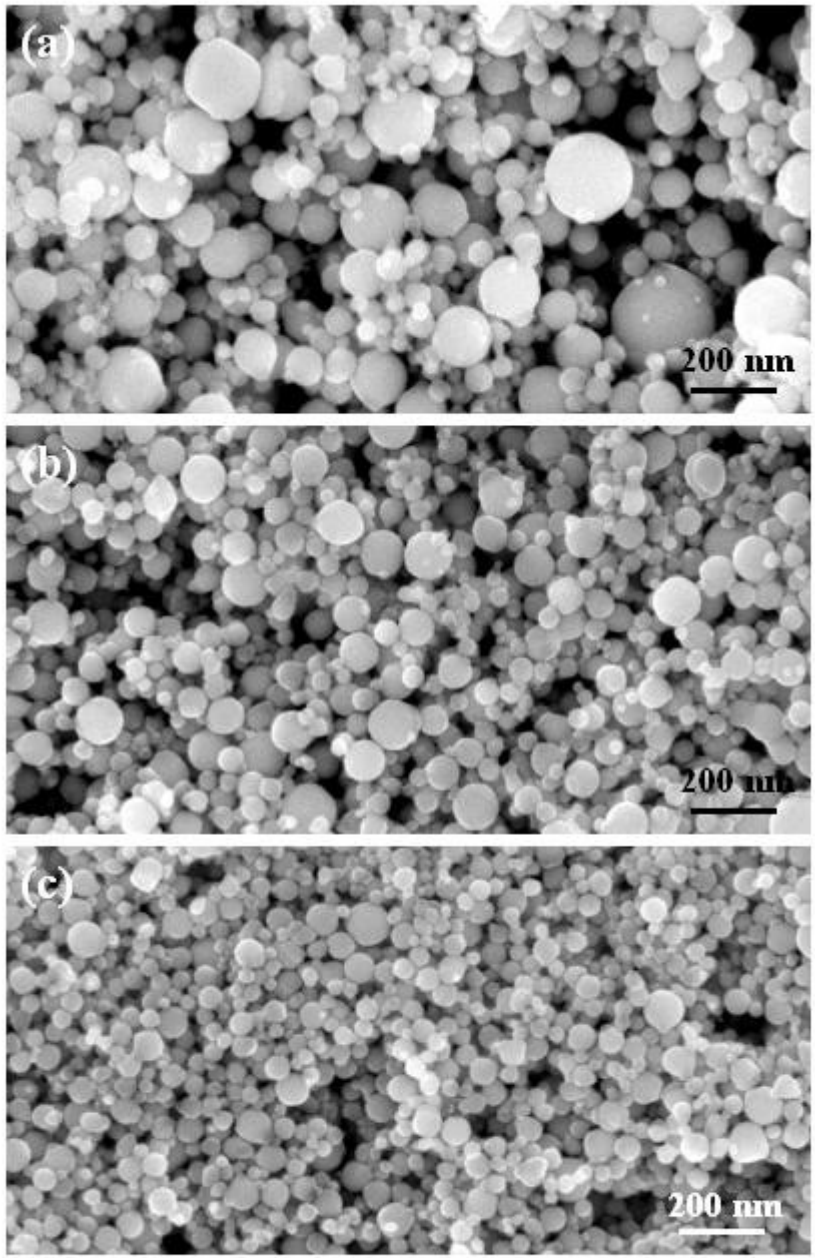

Fig. S7: Centrifugal separation of ceria nanoparticles of different sizes. (a) As-synthesized nanoparticles. (b) After one round of centrifugal separation, and (c) after 5 rounds of centrifugal separation.

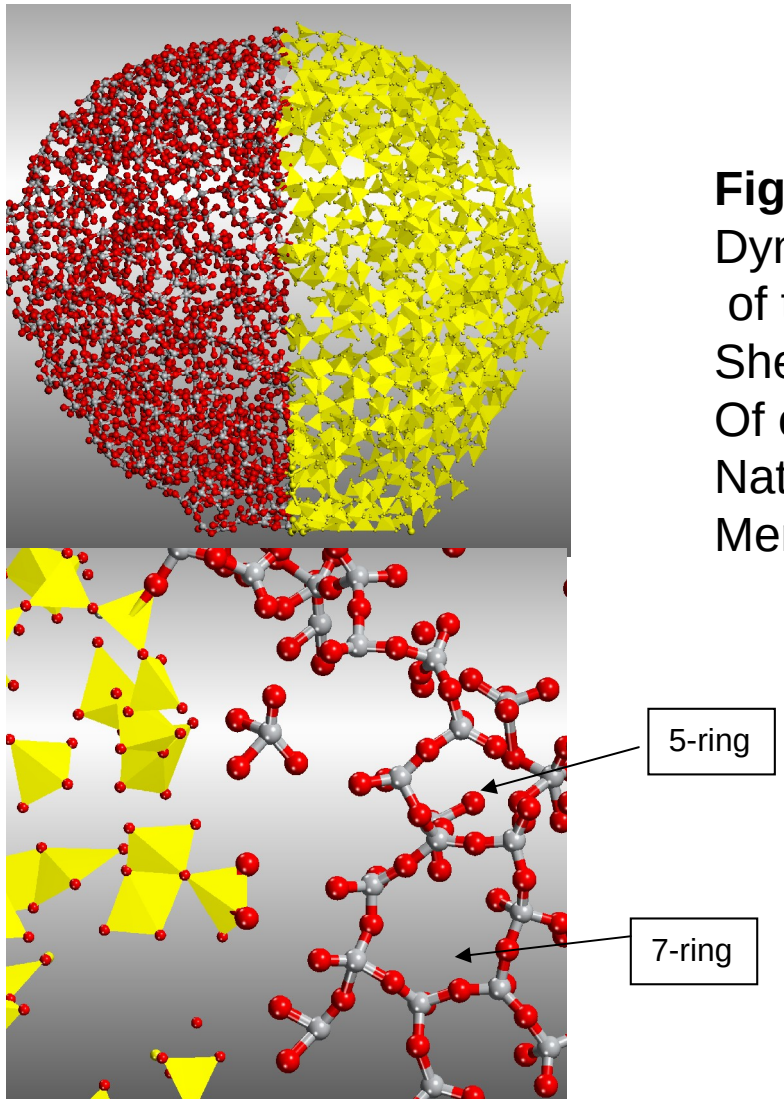

Fig. S8
Dynamic Simulation
of the TiO2 amorphous
Shell showing short range
Of order, but amorphous
Nature with 5- and 7-
Member rings

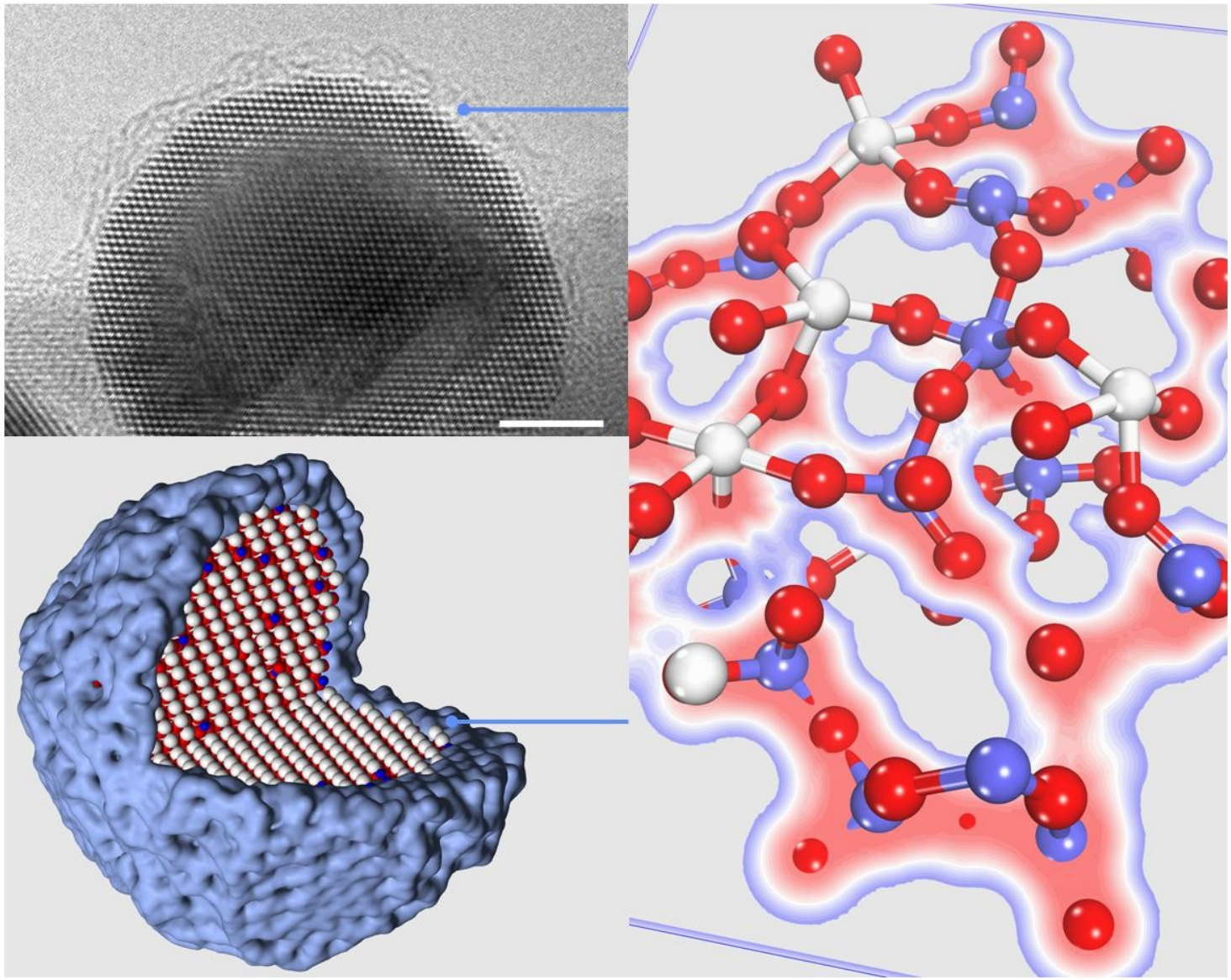

Fig S9. Up left: TEM image of a Ti-doped Ceria sphere and single-crystalline nanoparticle
Lower-left: Model of a Ti-doped Ceria sphere and single-crystalline nanoparticle
Right: Molecular model of the amorphous shell of TiO2 on the nanoparticle

Table S1. CMP Slurry Compositions and Characteristics

	Slurry A	Slurry B	Slurry C	Slurry D
CeO_2	1.0 wt%			
$Ce_{0.94}Ti_{0.06}O_2$		1.0 wt%		
$Ce_{0.88}Ti_{0.12}O_2$			1.0 wt%	
$Ce_{0.75}Ti_{0.25}O_2$				1.0 wt%
Proline	1.0 wt%	1.0 wt%	1.0 wt%	1.0 wt%
Water,	98 wt%	98 wt%	98 wt%	98 wt%
pH	4.01	3.87	3.86	3.99
Size, D_0, μ	0.669	0.584	0.766	1.005
Size, D_{mean}, μ	0.153	0.136	0.139	0.175
SiO2, Removal Rate, nm/min	195	224	300	295
Defect: Total	45	45	32	35
Defect: Scratch	8	16	7	3
Defect: Adders	45	45	29	32

The SiO_2 film layer for CMP testing was a 1000 nm thermal oxide film on a silicon wafer. The wafers were polished using a Strasbaugh 6EC polisher, a Rodel IC1000 pad with Suba IV backing at a down pressure of 3.2 psi, and a table rotation speed of 60 rpm, and slurry flow rate of 150 ml/min. The defect study was performed on patterned silica wafers using a two-step process. The defects was examined with a SEM defect detector. For the polishing, the slurry mixture was adjusted to pH 4 using nitric acid. The slurry was then subjected to high shear mixing for 30 minutes and is read for CMP testing.