nanomaterials

2nd International Online-Conference on Nanomaterials

MENDELEEV UNIVERSITY

Self-assembly of nanoclusters in molybdenum blue dispersions in the presence of organic reducing agent

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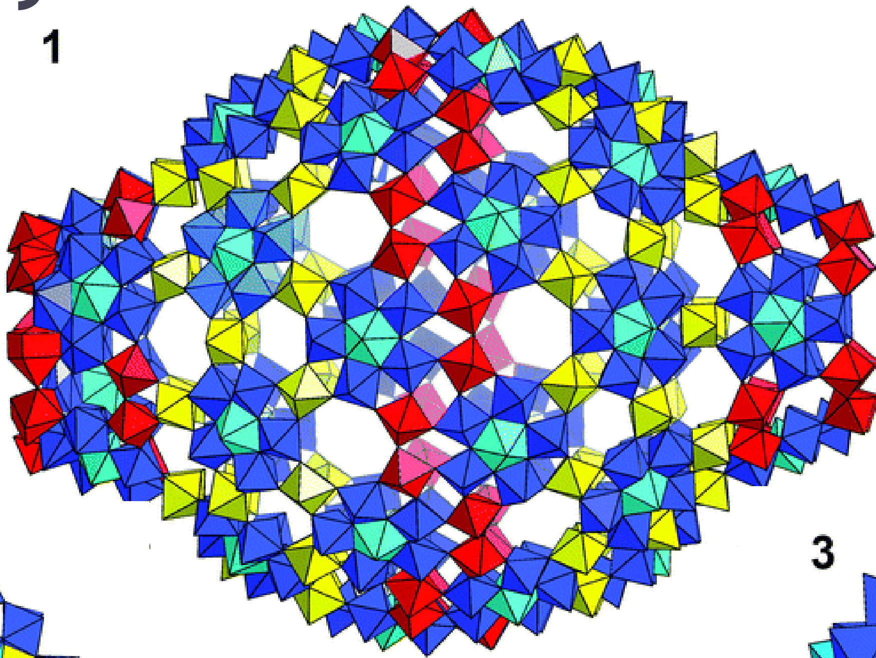
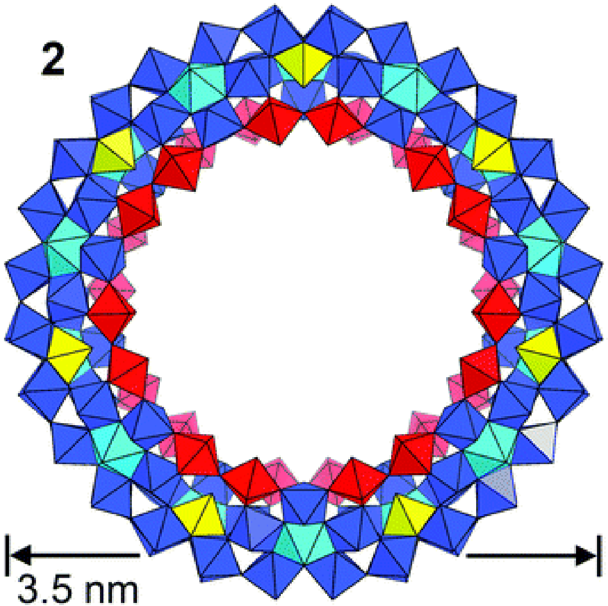
Polyoxometalate clusters

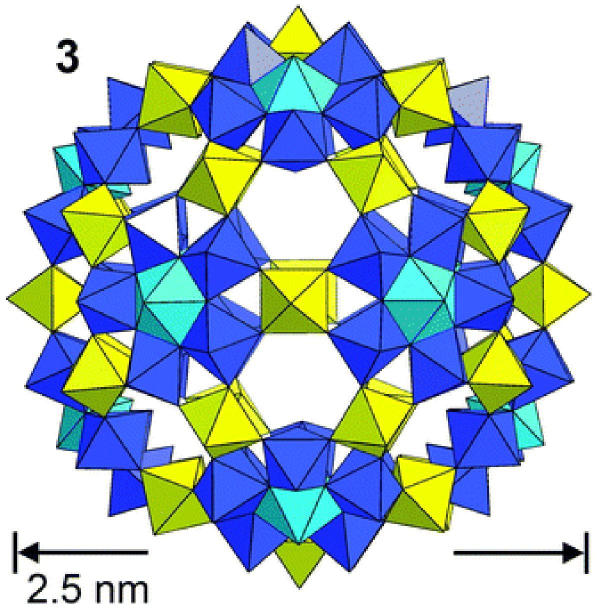


{Mo_{138}}-3,5 nm,
toroidal shape*



{Mo_{368}}-5,5 nm,
lemon like shape*

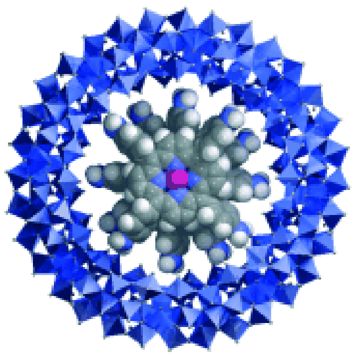
{Mo_{132}}-2,5 nm,
spherical shape*



* Müller A., Serain C. Polyoxometalates: From Platonic Solids to Anti-Retroviral Activity // Acc. Chem. Res. 2000. V. 33. P. 2.

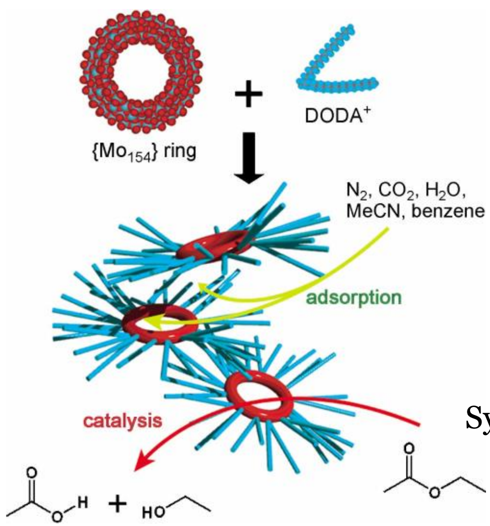
Perspective application of molybdenum blue dispersions

Medicine

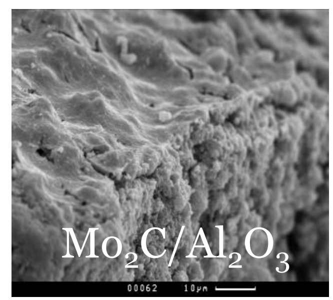


Targeted drug delivery *

Catalysis

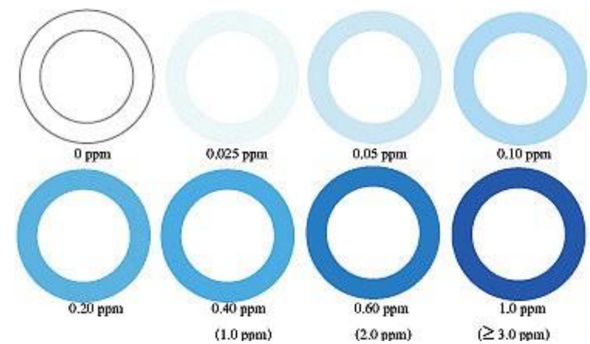


Catalytic hydrolysis of ethyl acetate**



Synthesis of catalysts Mo_2C/Al_2O_3 by sol-gel method

Analytical chemistry



Express analysis of phosphate

*A. Tsuda, E. Hirahara, Y. – S. Kim, H. Tanaka. A molybdenum crown cluster forms discrete inorganic – organic nanocomposites with metalloporphyrins // Angew. Chem. Int. Ed. V. 43. 2004. P.6327.
**S.-I. Noro, R. Tsunashima, Y. Kamiya. Adsorption and catalytic properties of the inner nanospace of a gigantic ring-shaped polyoxometalate Cluster//Angew. Chem. Int. Ed. V.48. 2009. .P. 8703.

Synthesis of molybdenum blue dispersions

Compounds Mo (VI)

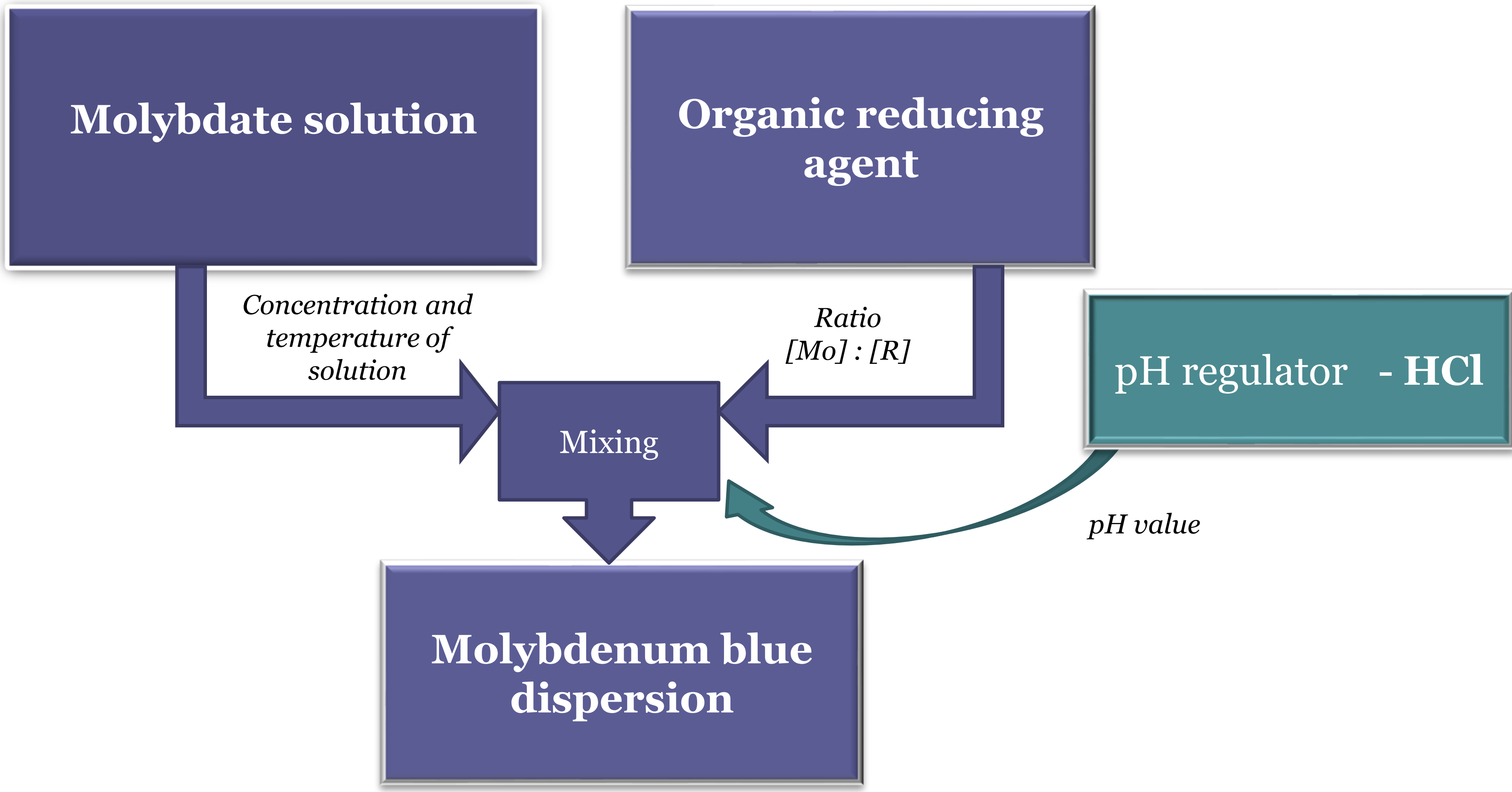
- **Chemical reduction**

(inorganic reducing agents: Al, Sn, $SnCl_2$, $NaBH_4$, etc.)

(organic reducing agents: glucose, hydroquinone, ascorbic acid, etc.)

- **Photochemical reduction**
- **Electrochemical reduction**
- **γ - radiation**

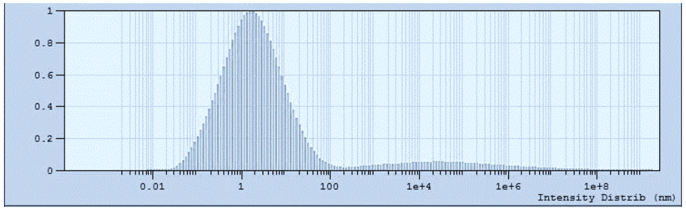
Synthesis of molybdenum blue dispersions



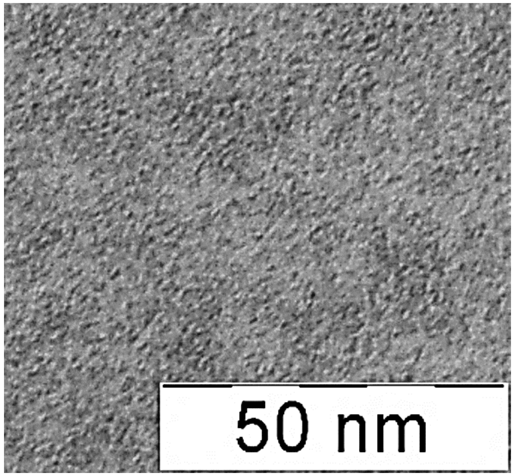
Synthesis conditions

Parameter	Reducing agent		
	Glucose	Hydroquinone	Ascorbic acid
Synthesis conditions			
Interval [R]/[Mo]	5,0-9,0	3,0-6,0	0,6 – 5,0
Interval $[H^+]/[Mo]$	0,5-0,8	1,0-4,0	0,5-1,0
Time proceeding			
Time to reach constant particle concentration, days	< 20	< 20	< 10
Time of maintaining a constant concentration of particles, days	> 60	< 10	> 30

Formation of molybdenum blue dispersions

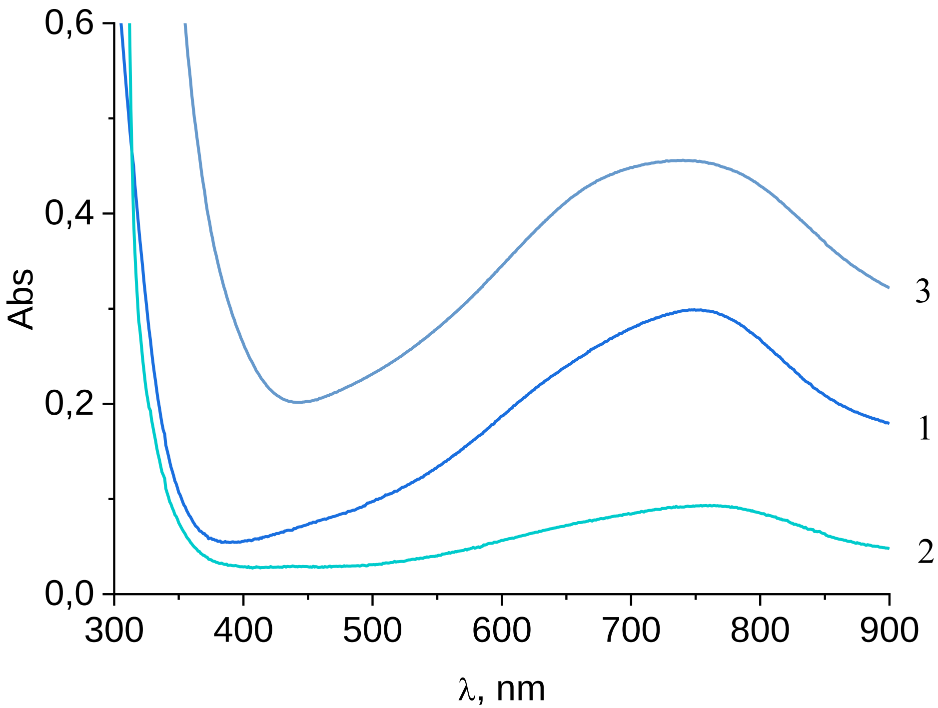


(a)



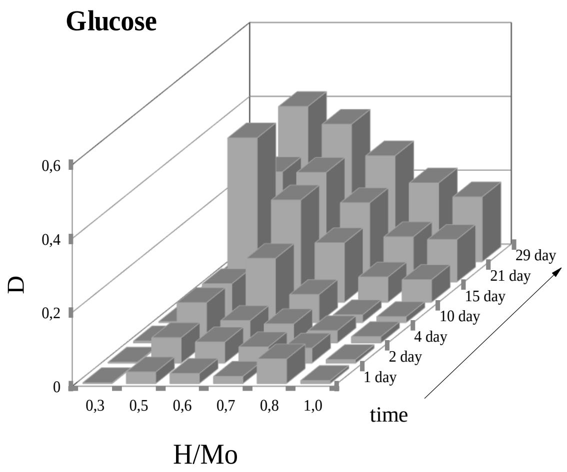
(b)

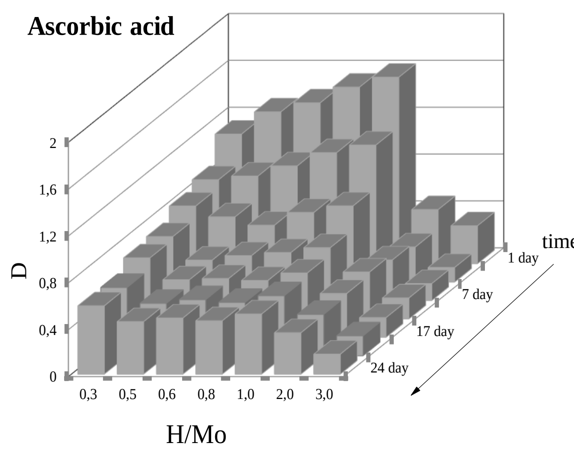
DLS distribution (a) and TEM-image (b) of molybdenum blue particles, synthesized by using ascorbic acid.

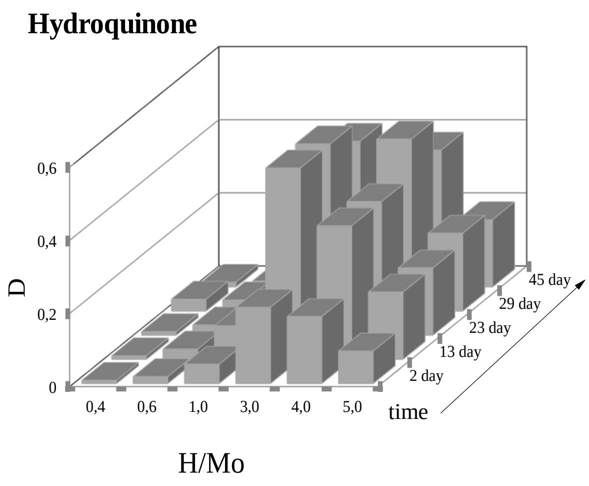


The electronic absorption spectrum of dispersion of molybdenum oxide clusters synthesized using various reducing agents: glucose (1), hydroquinone (2), ascorbic acid (3).

Formation of molybdenum blue dispersions Time effect

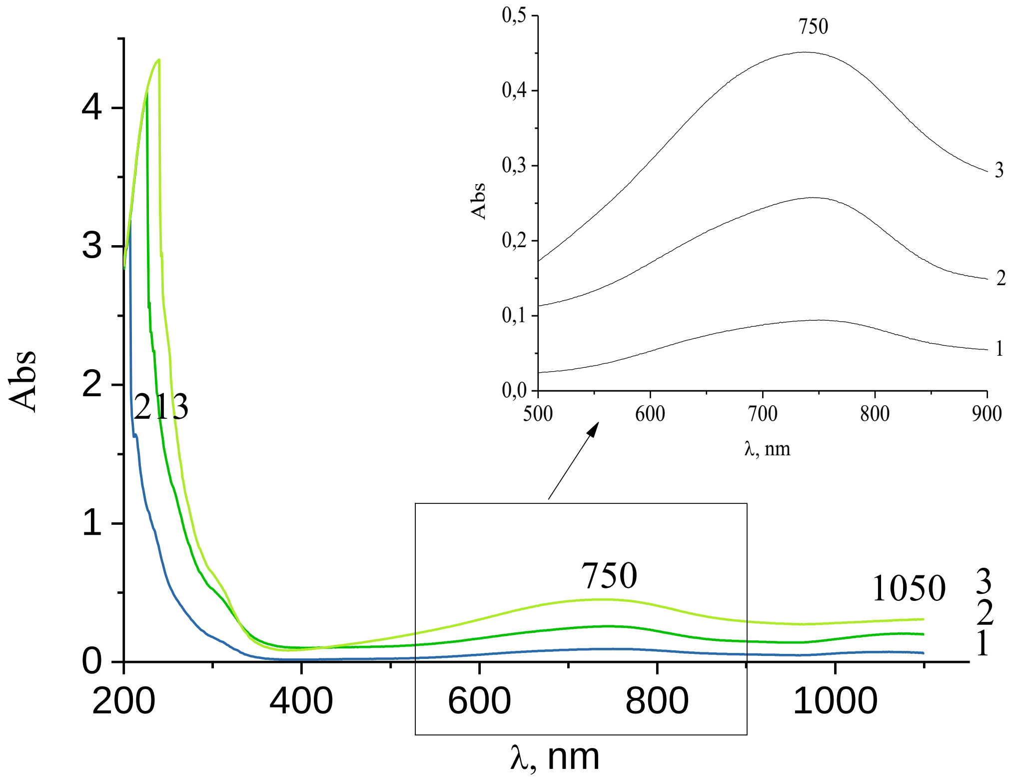




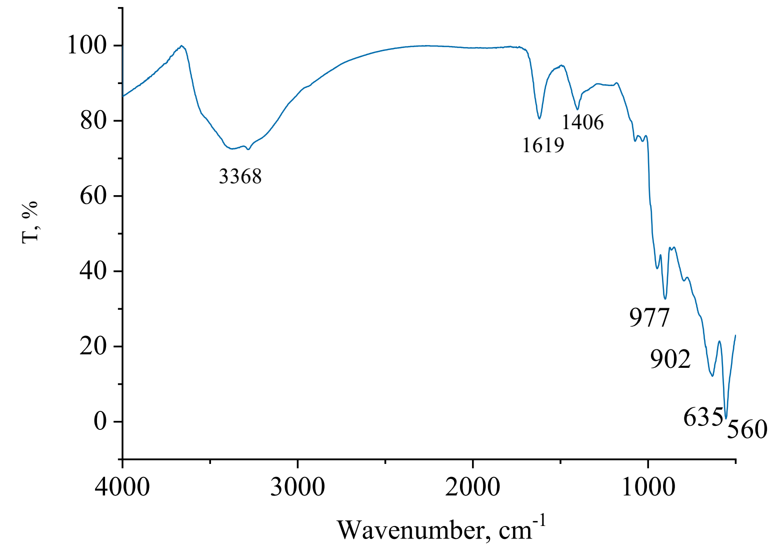


* Hydrodynamic radius is determined by dynamic light scaterring (Photocor Compact Z)

Nanocluster characterization
I. Uv-Vis and FTIR - spectroscopy



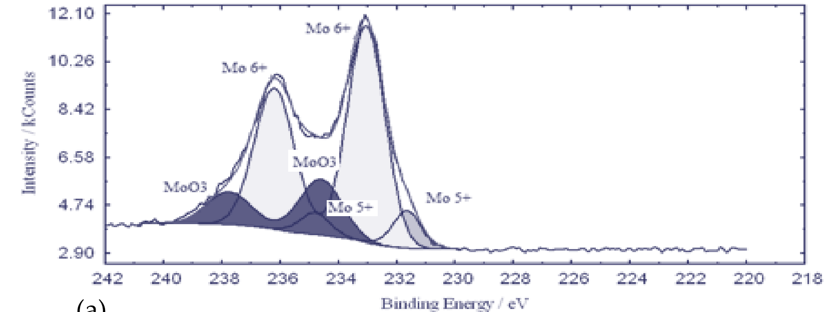
The electronic absorption spectrum of molybdenum oxide clusters isolated from dispersions synthesized using various reducing agents: glucose (1), hydroquinone (2), ascorbic acid (3).



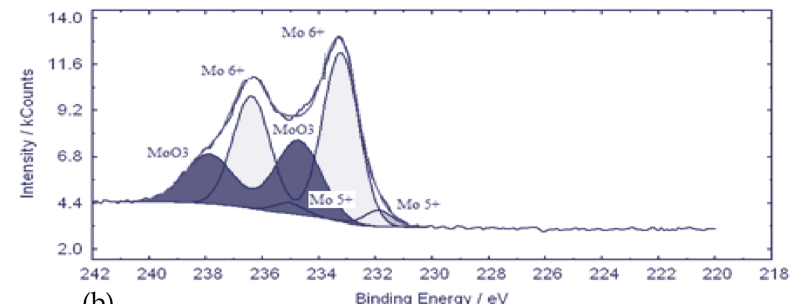
FTIR spectra of molybdenum oxide clusters isolated from dispersions synthesized by using glucose

Band position, cm^{-1}	Assignment
3368s	ν(OH…H)
1620s	δ(H_2O)
1406w	δ(NH_4^+)
973s, 904w	ν(Mo=O)
737s, 634m	ν(Mo-μ_2O-Mo) or ν(Mo-μ_3O-Mo)
561s	δ(O-Mo-O)

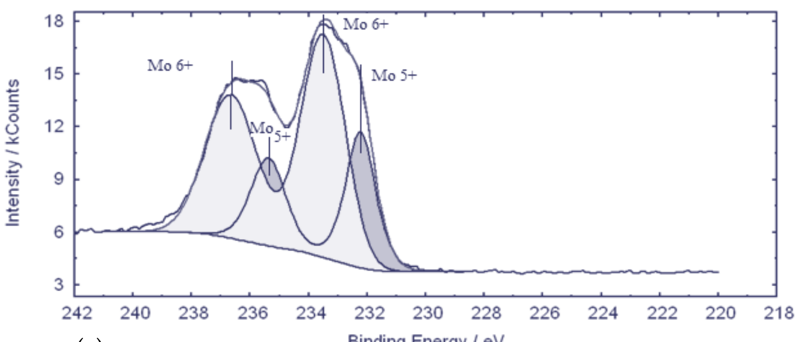
Nanocluster characterization
II. XPS spectroscopy



(a)

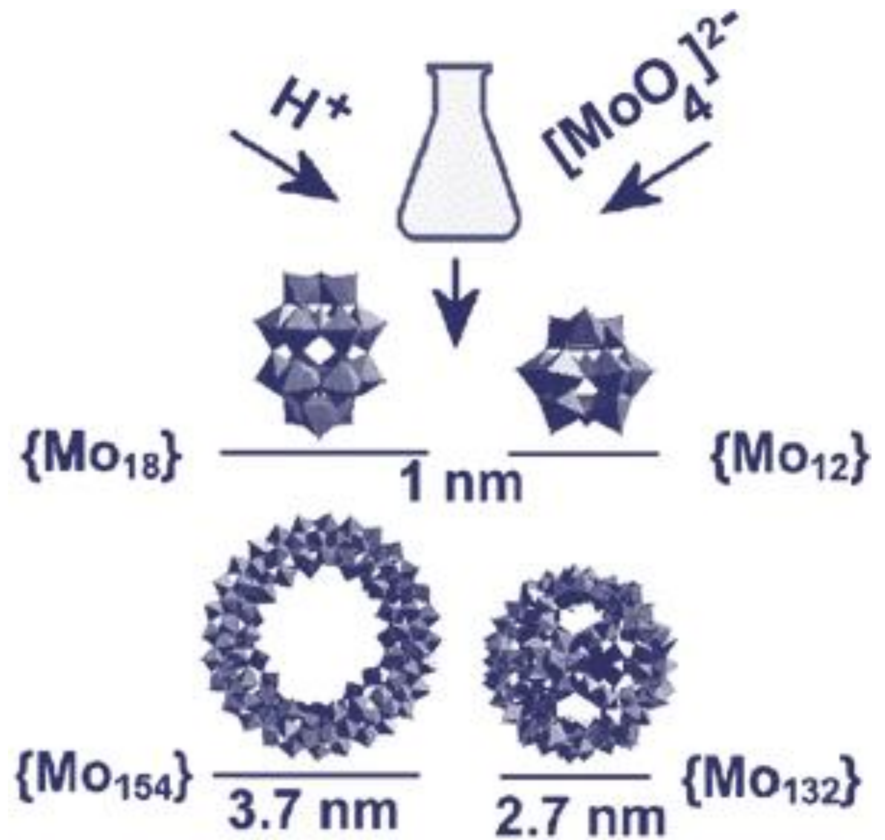


(b)



(c)

XPS spectrum of Mo (a) and O (b) of synthesized molybdenum clusters by using various reducing agents: glucose (a), hydroquinone (b), ascorbic acid (c).



* H. N. Miras, E.F. Wilson, L. Cronin Unravelling the complexities of inorganic and supramolecular self –assembly in solution with electrospray ana criospray mass spectroscopy // Chem. Communi. 2009.P.1297 – 1311.

Thank you for attention !

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