Preparation of spherical doped Y2O3 nanoparticles and laser ceramics on their basis.

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Contents

1. Agglomeration of YAG and Y_2O_3 nanoparticles
2. Y_2O_3 spheres' nanopowder
3. Compaction
4. Y2O3 ceramics
5. YAG ceramics

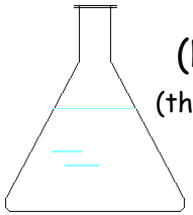
Synthesis of Transparent YAG Ceramics

Non-Reactive sintering

Precipitation/ Calcination route

(Dr. Ueda's group, Konoshima Chem. Co.)

Y^{3+}, Al^{3+}, Nd^{3+} salts in aqueous solution



$(NH_4)HCO_3$ or urea
$(NH_4)_2SO_4$ + Colloidal SiO_2
(thermal decomposition of urea at 95°C)

Monodisperse YAG precursor nanoparticles

Separation
Washing
Drying
Calcination at 1200°C

Nd^{3+} :YAG powder

Wet ball milling
Binder
Molding
Vacuum sintering at 1750°C, 10^{-6} torr during 10 h

Transparent Nd^{3+} :YAG ceramic

Reactive sintering

Solid-state reaction route

(Dr. A. Ikesue)

Oxides Y_2O_3 + Al_2O_3

Ball milling,
Ethanol + $(C_2H_5O)_4Si$
Spray drying

Fine silica-coated Y_2O_3 + Al_2O_3 particles (size <1 μm)

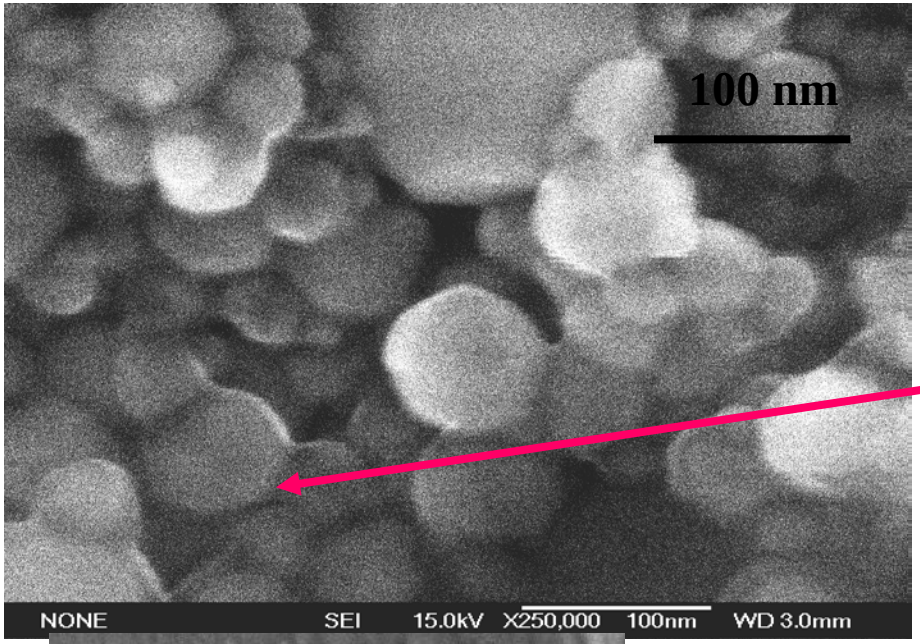
Binder
Isostatic pressing

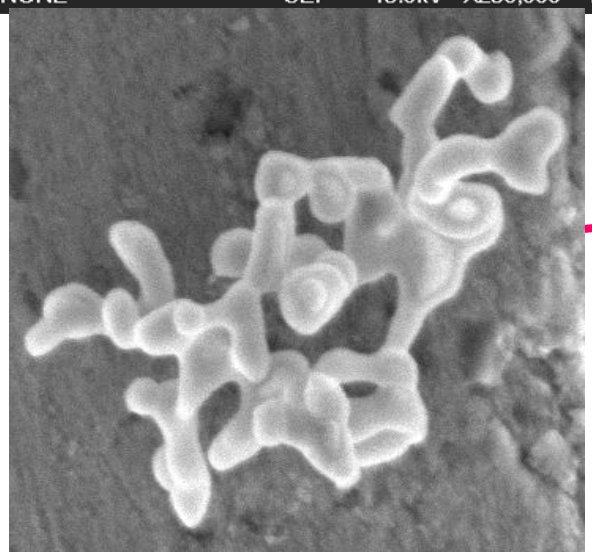
Vacuum sintering at 1750°C, 10^{-6} torr during 10 h

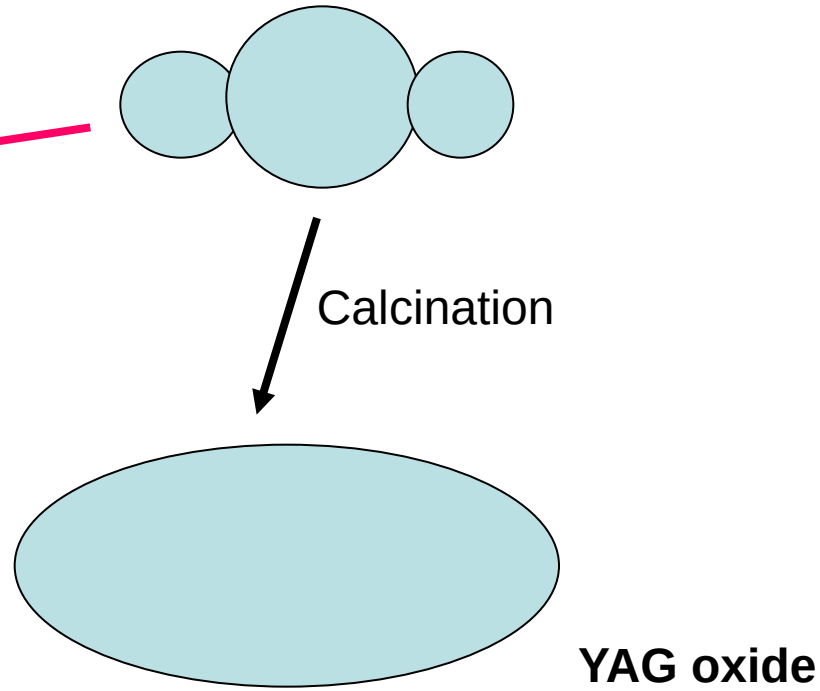
Transparent Nd^{3+} :YAG ceramic

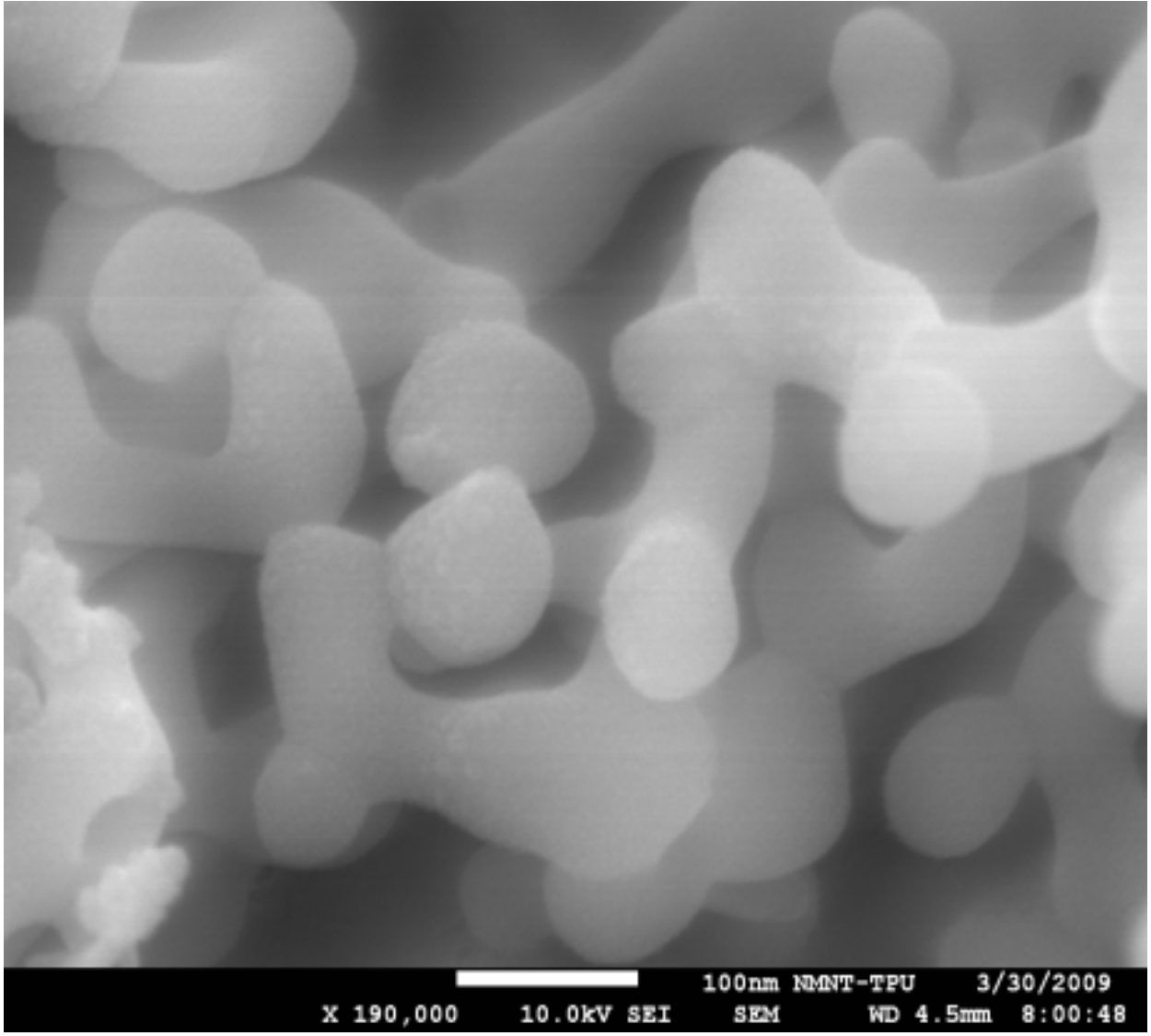
There are two approaches to transparent ceramic fabrication.
Byer, LCS-3, Paris.

YAG nanoparticles agglomeration

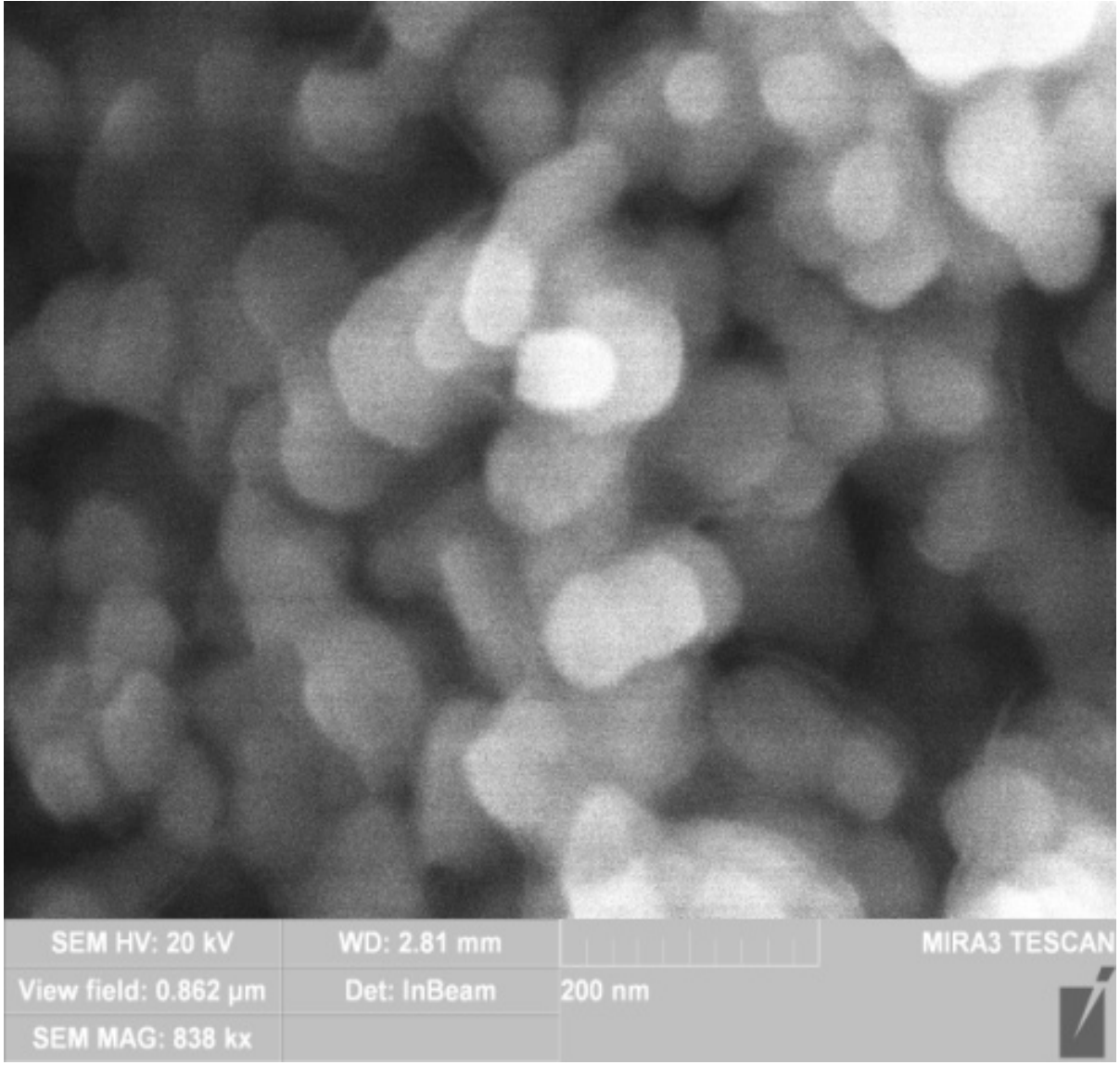




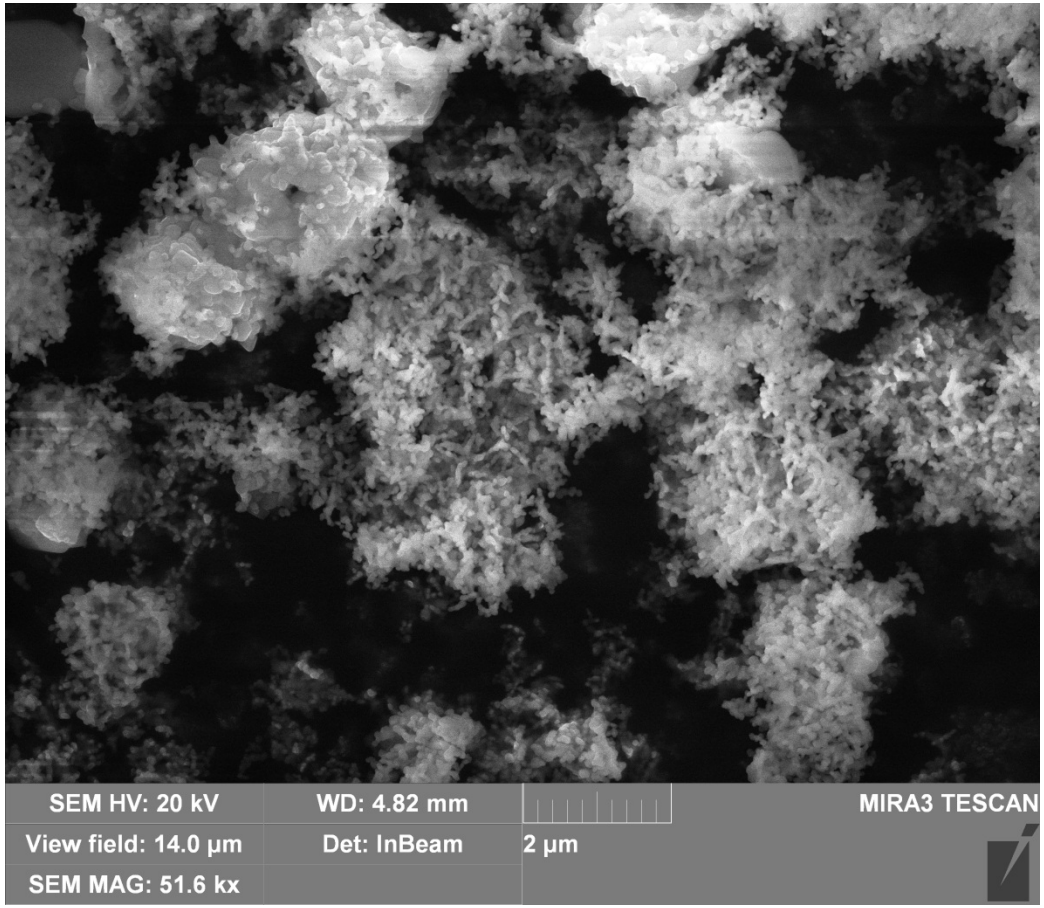




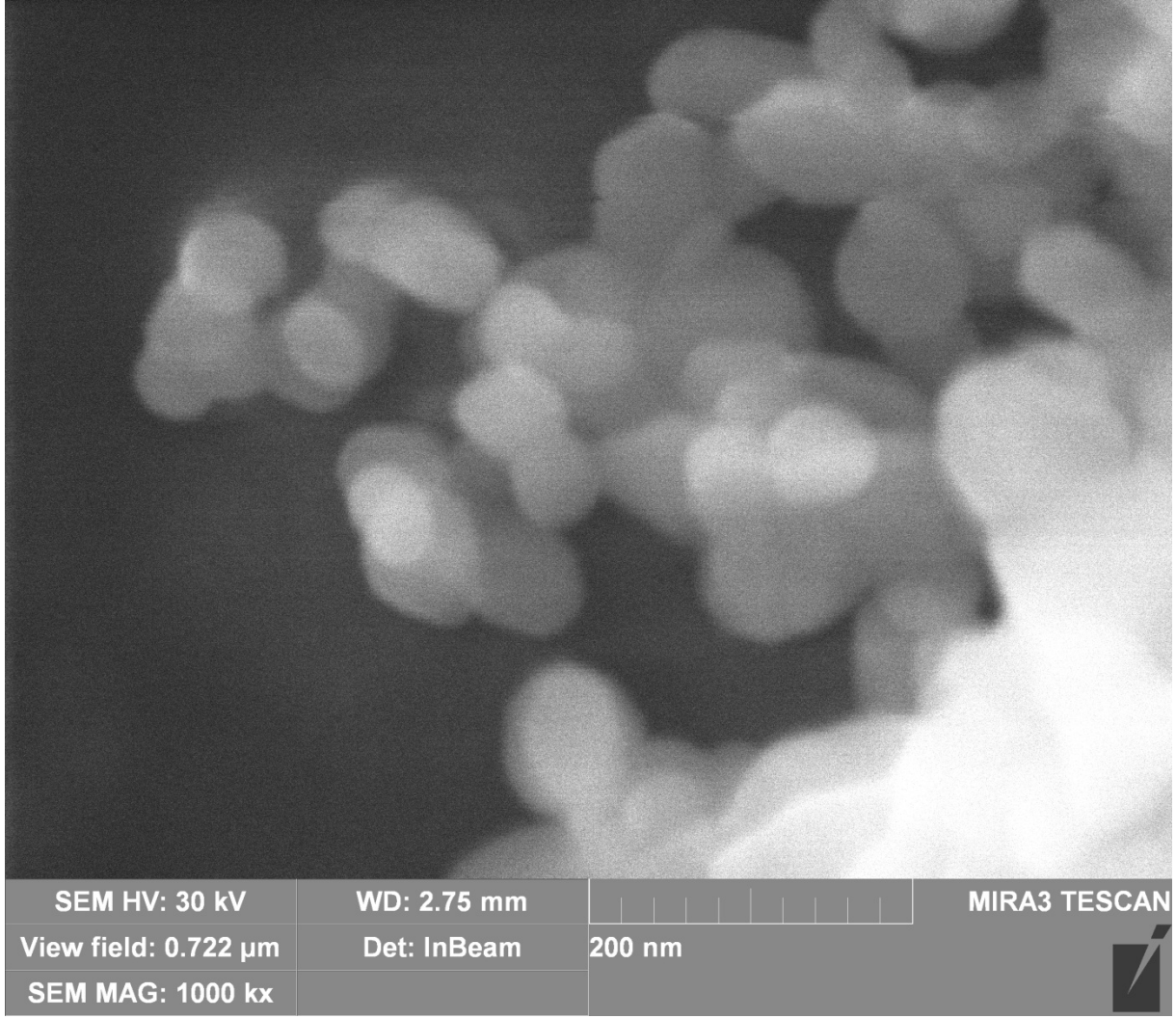
YAG nanopowder obtained from nitrate solutions. Heat treatment 1100 oC 2, 2 hours



YAG nanopowder obtained from chloride solutions. Heat treatment 1100 oC, 2 hours

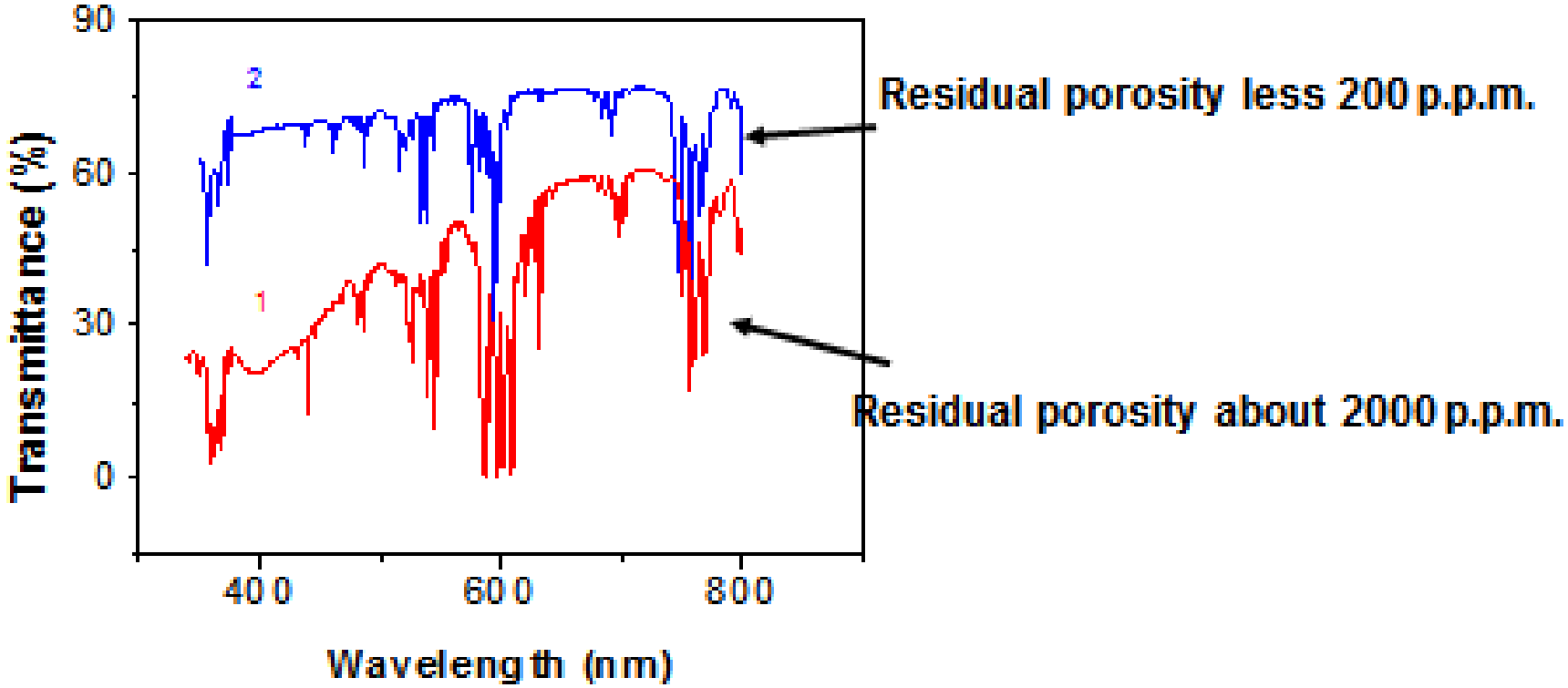


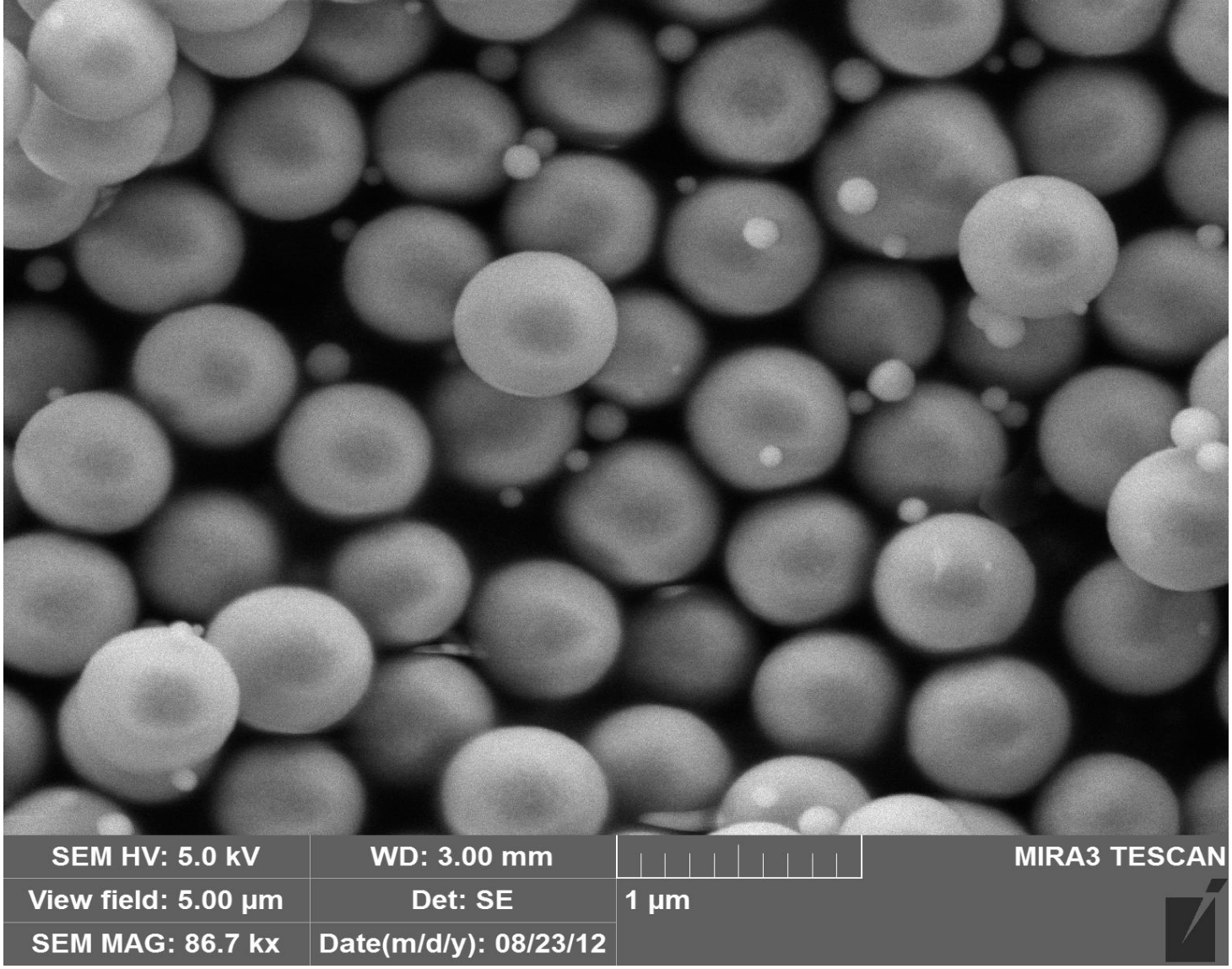
Y_2O_3 nanopowders prepared from chloride solutions. General view.



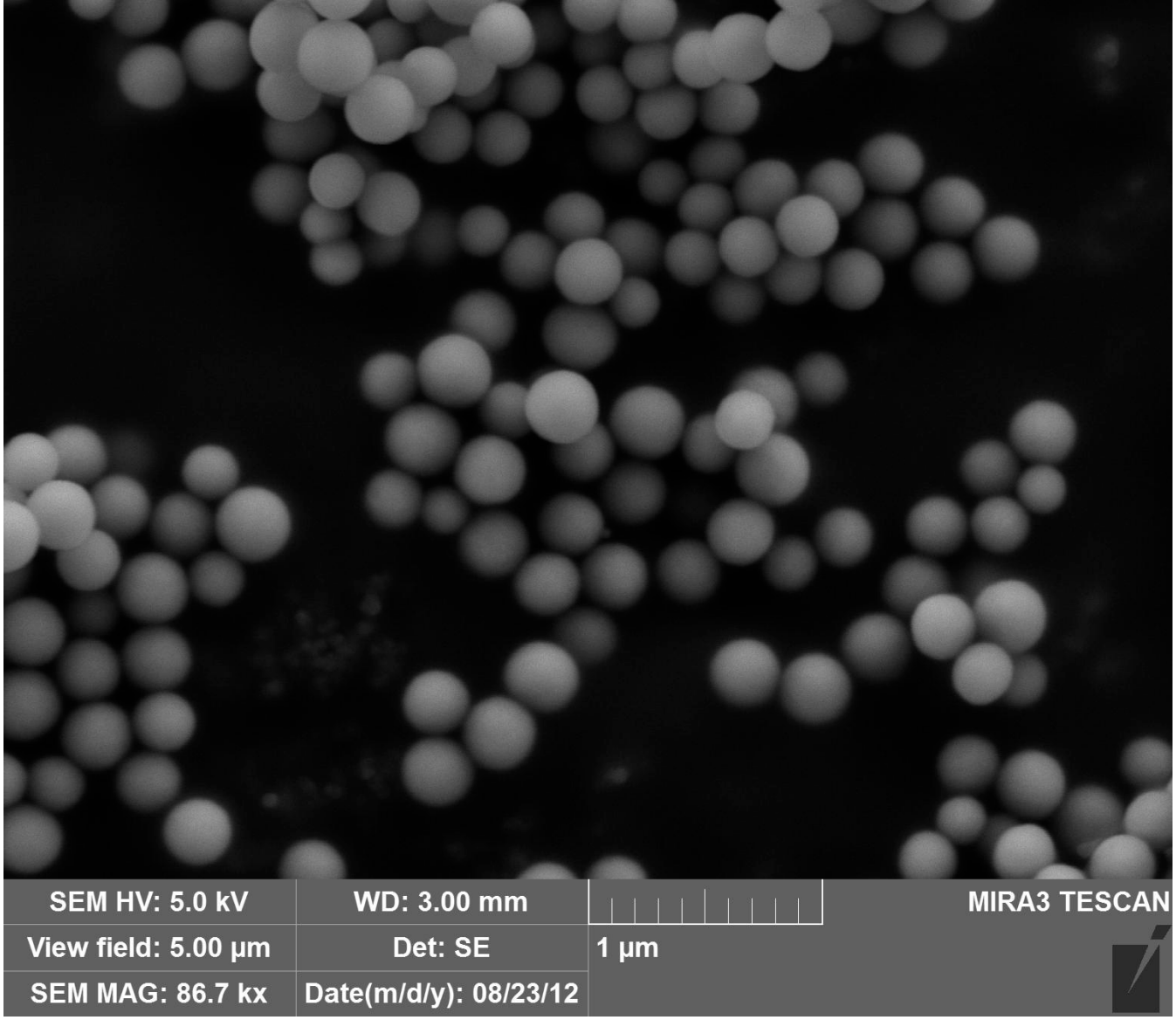
Y_2O_3 nanopowders prepared from chloride solutions. Details.

Transparency and porosity of samples

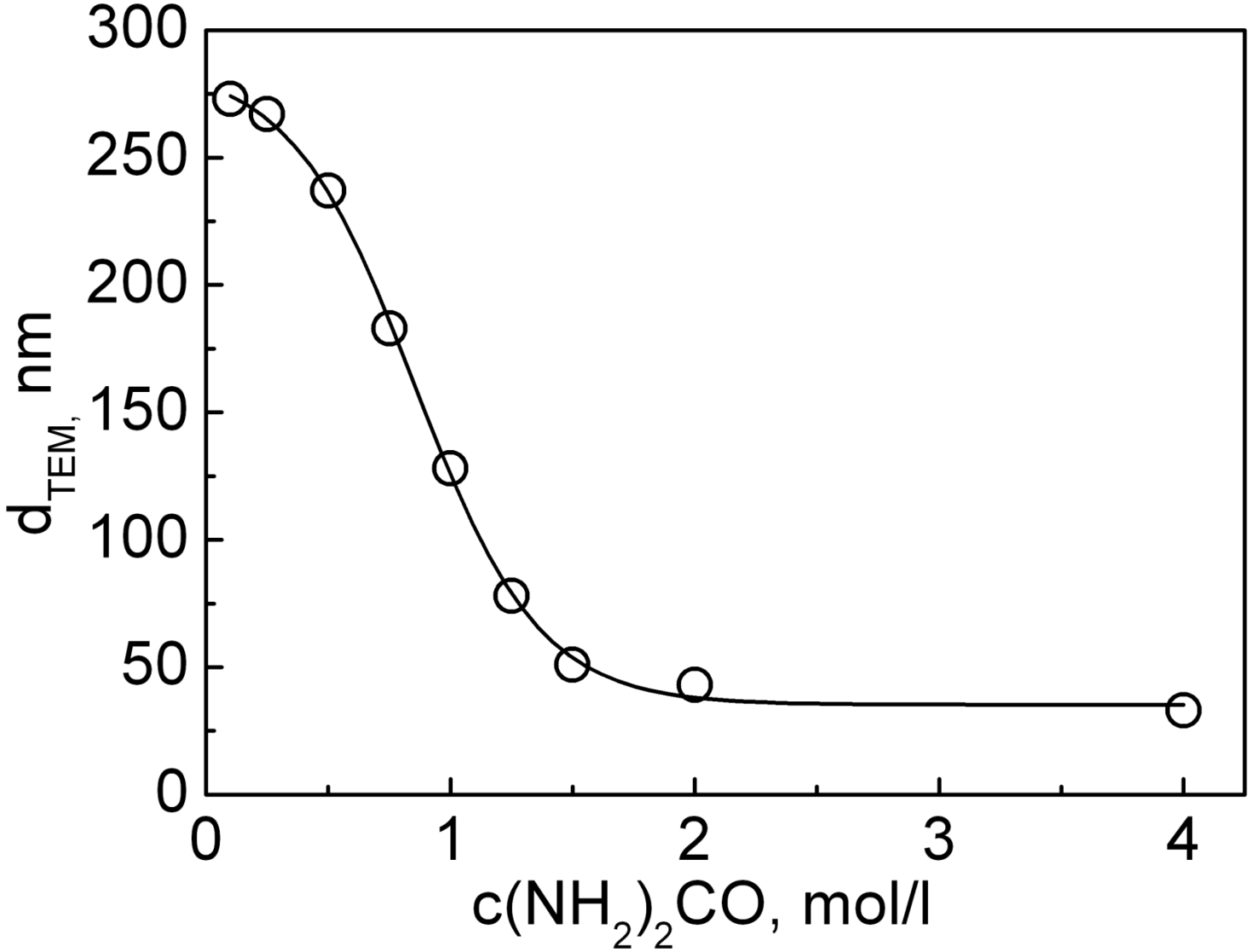




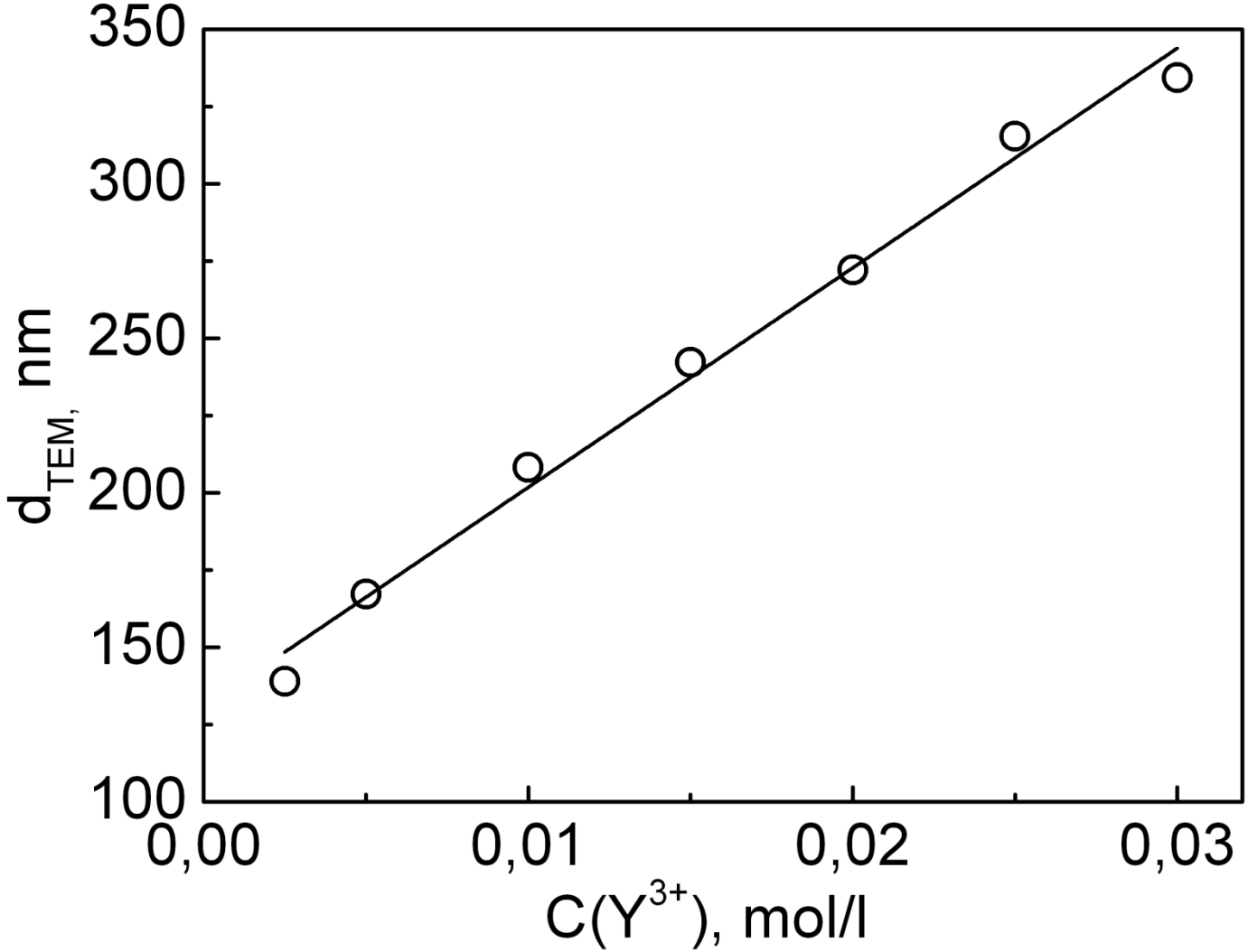
(Yb0,1La0.1Y0.8)2O3 nanopowder obtained by homogeneous precipitation



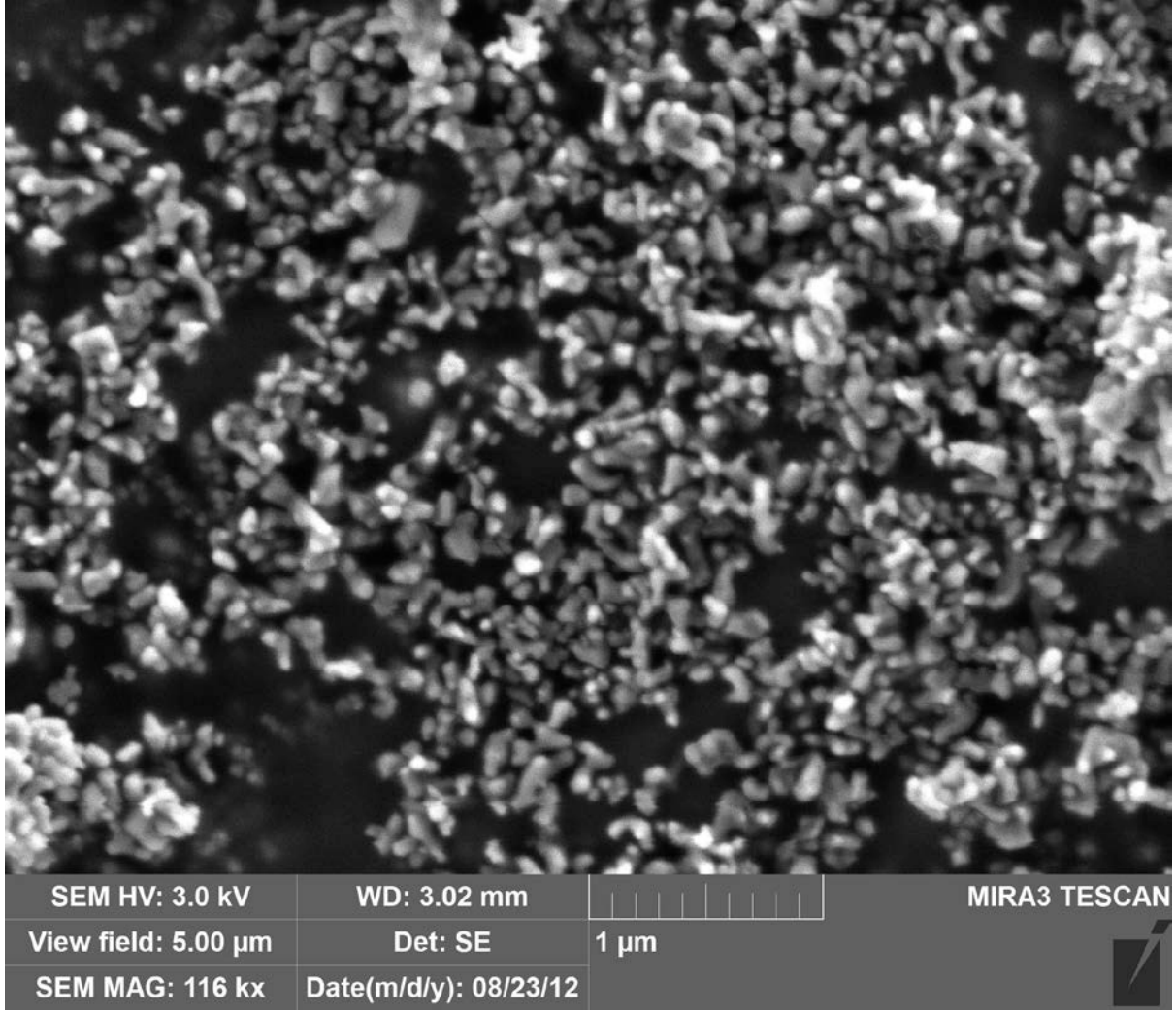
Y_2O_3:Nd_2O_3 (1%), nanopowder obtained by homogeneous precipitation



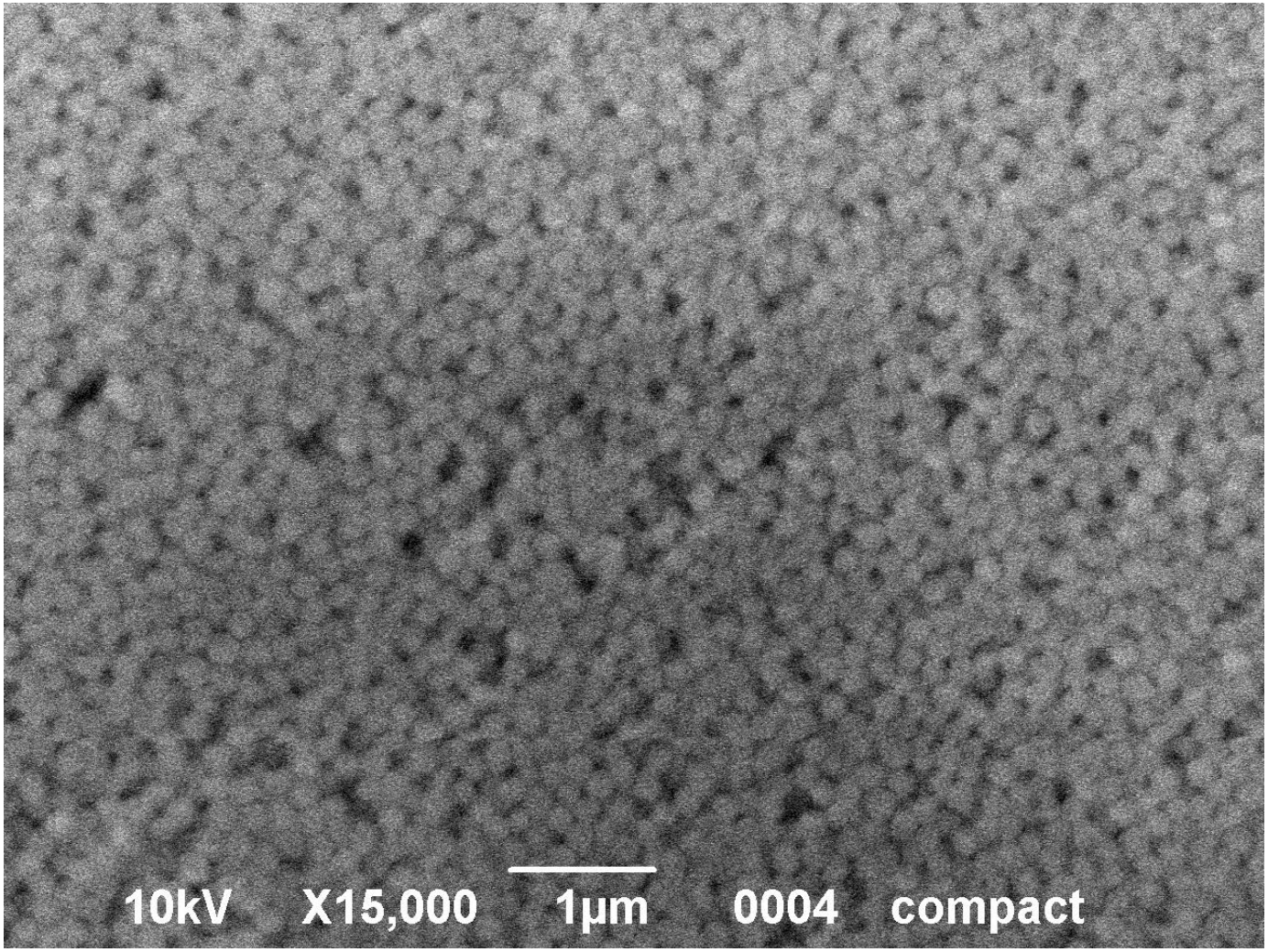
Y2O3 spheres size dependence on urea concentration (R.P.Yavetskiy, 2012)



Y2O3 spheres size dependence on YCl3 concentration (R.P.Yavetskiy, 2012)



Commercial Al2O3 nanopowder, Baikowski, France



Picture of splitted compact made of spherical Y_2O_3 nanopowder

Compaction:

-Slip casting

-Uniaxial pressing

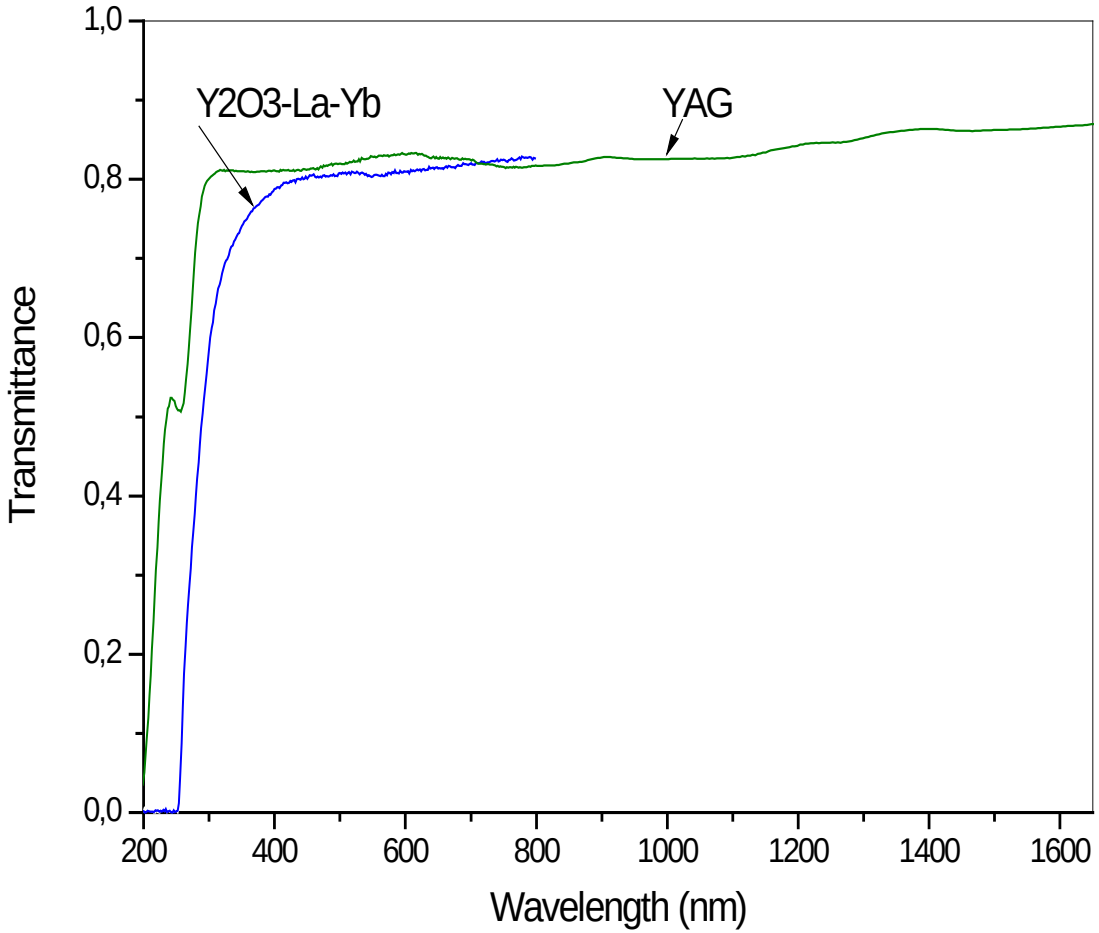
-Quasi-isostatic cold pressing

-Isostatic cold pressing

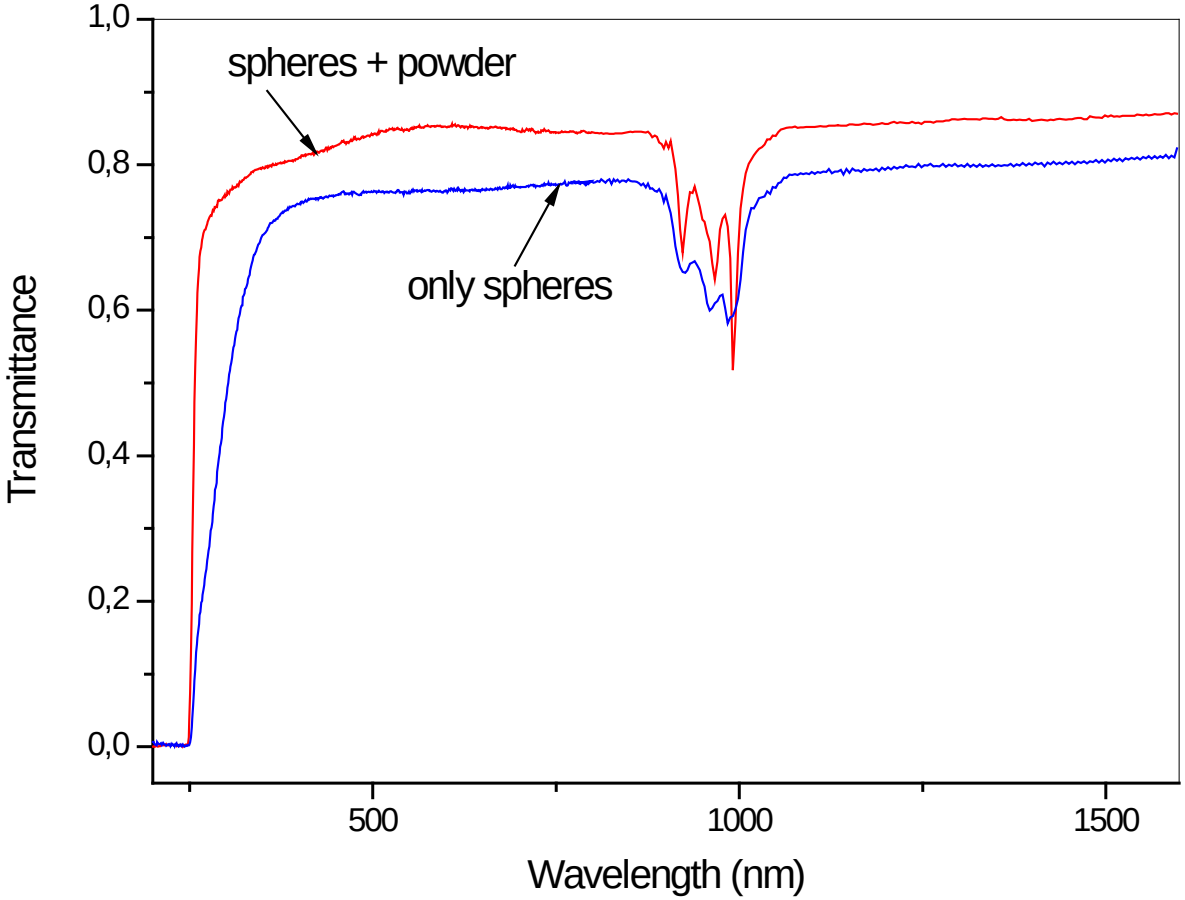
-Magneto-impulse

Sintering:

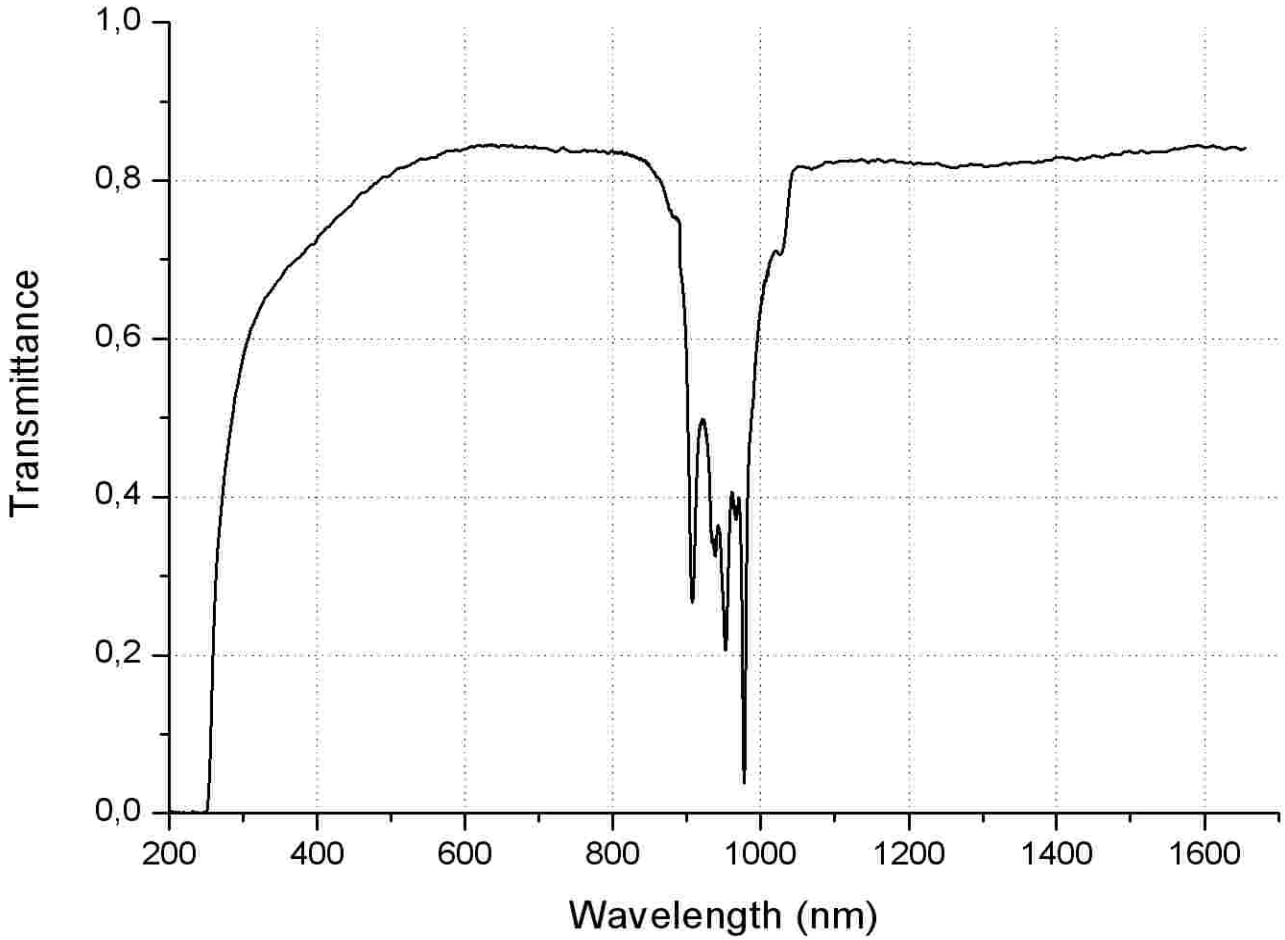
Vacuum, 1600-1750 oC



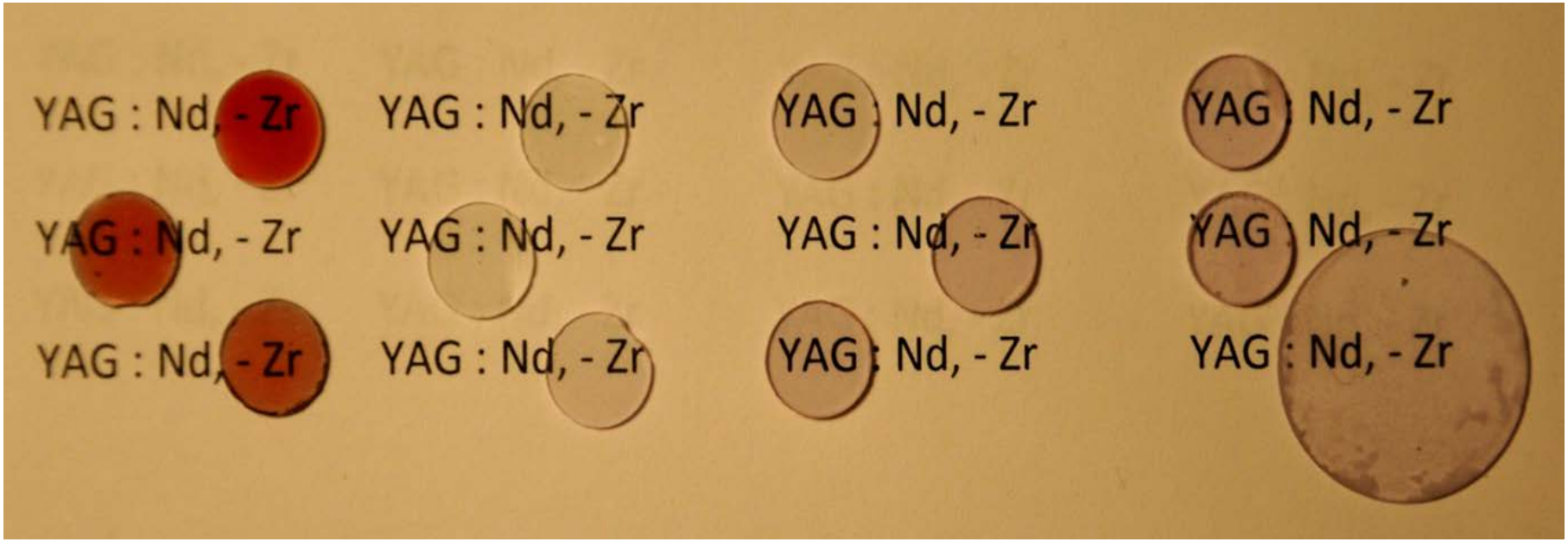
Optical transmittance of undoped Y2O3-La-Yb (blue) and YAG (black)



Optical transmittance of (Yb,La,Y)2O3 ceramics obtained with (Yb,La,Y) spheres (blue) and with (Yb,La)2O3 spheres and La2O3 nanopowder (red)



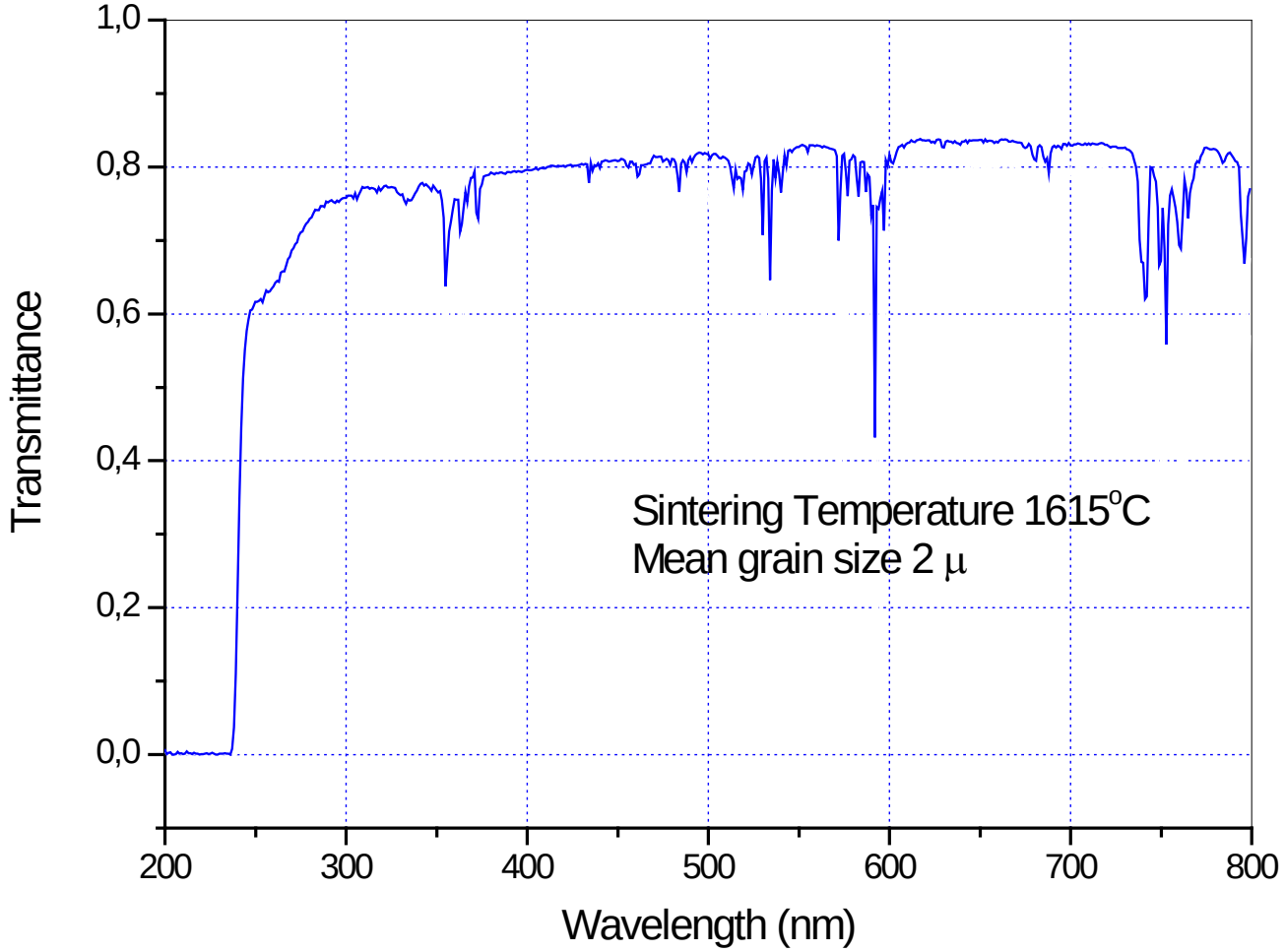
Optical transmittance of Yb0,11La0,23Y1,66O3



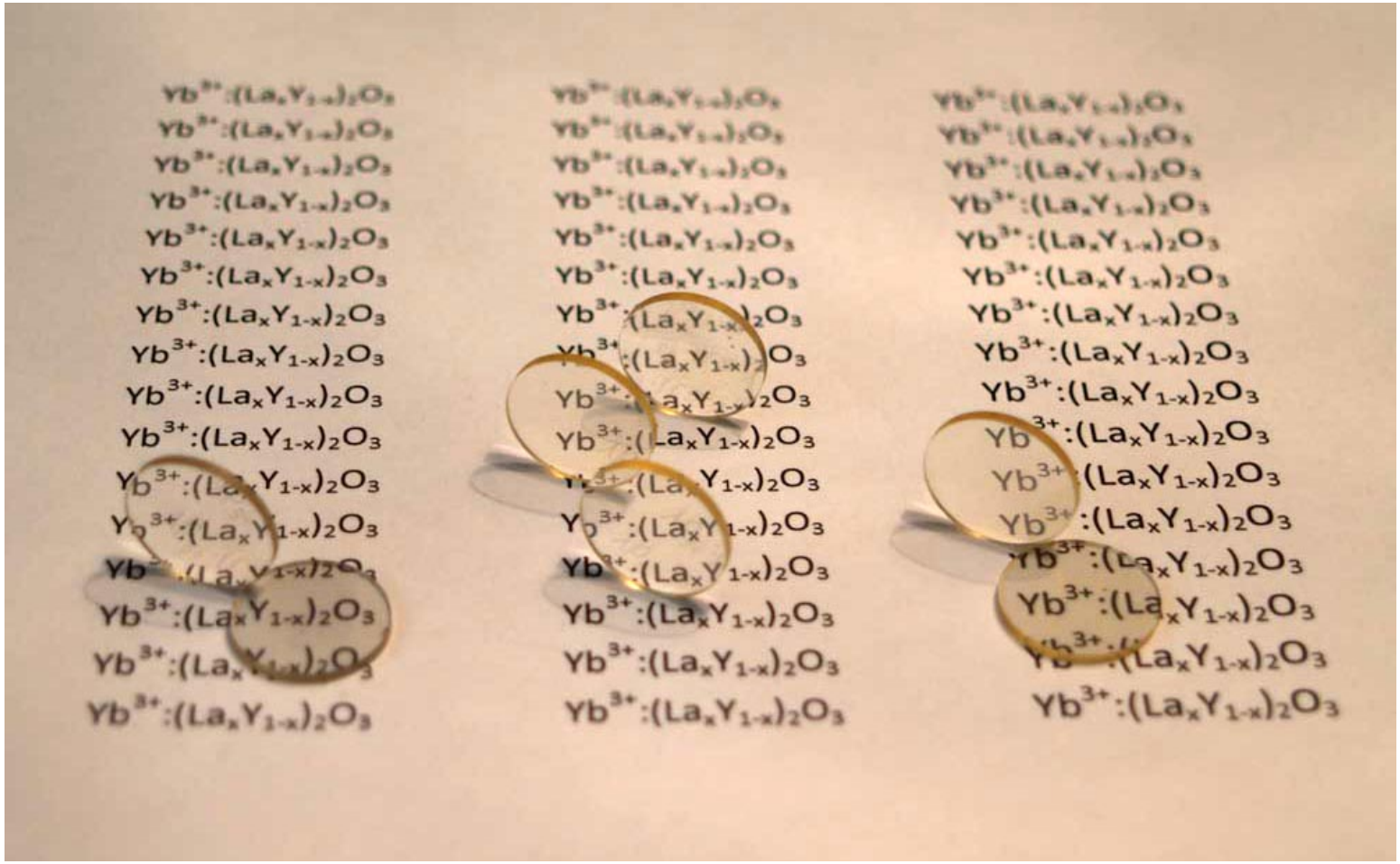
Nd-doped YAG ceramics

7th Laser Ceramics Symposium:

International Symposium on Transparent Ceramics for Photonic Applications



Optical transmittance of different YAG:Nd ceramics



Yb3+ - doped (Y,La)2O3 ceramics

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