The influence of hafnium oxide additives on optical properties of Nd^{3+}-doped Y_2O_3 ceramics

V.V. Osipov, A.N. Orlov, R.N. Maksimov, V.V. Lisenkov, V.V. Platonov

Laboratory of Quantum Electronics
Institute of Electrophysics UB RAS, Ekaterinburg, Russia
e-mail:RomanMaksimov@e1.ru

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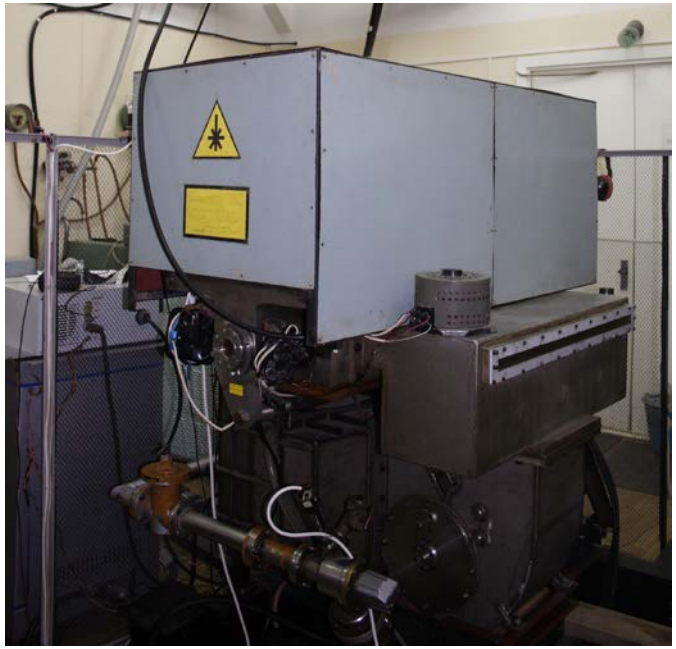
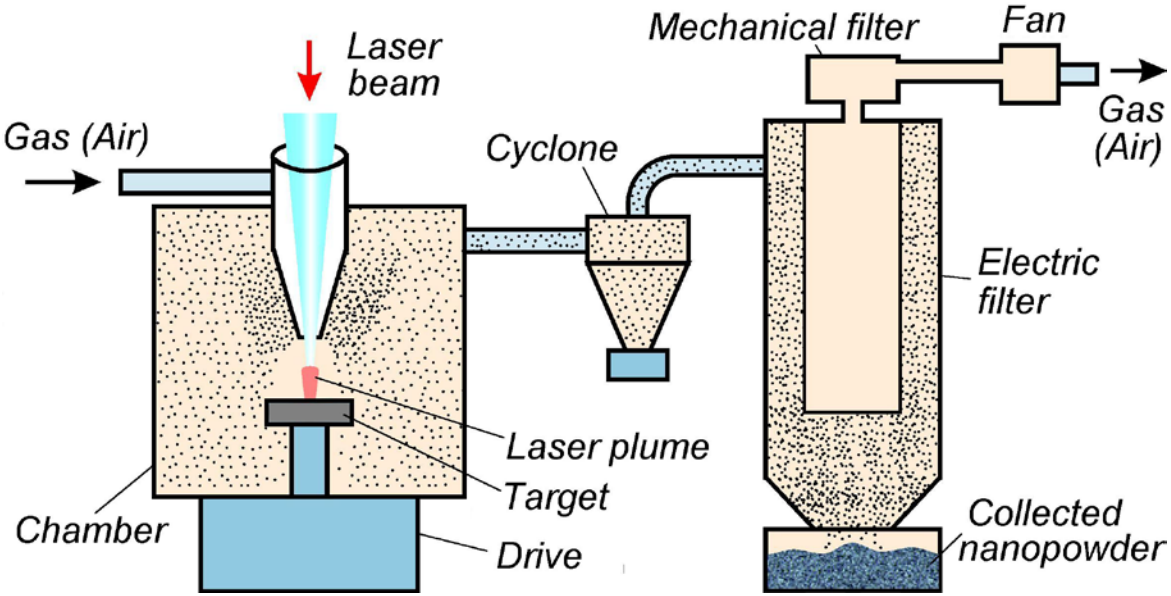
Outline

1. Fabrication process of Nd:Y_2O_3 - HfO_2 ceramics
2. Optical properties
   - ❖ Transmission spectra
   - ❖ Luminescence spectra
   - ❖ Effective lifetime
3. Conclusion

Production of nanopowders



Pulse-periodical CO_2-laser "LAERT"



Experimental facility

Main laser parameters:
- **Average power: 550 W**
- **Peak power: 8-9 kW**
- **Pulse duration: 330 μs**
- **Frequency: 500 Hz**

Output rate:
Nd:Y_2O_3: 28 g/h
HfO_2: 21 g/h

Fabrication process of $Nd:Y_2O_3$ - HfO_2 ceramics

Laser synthesis of nanopowders

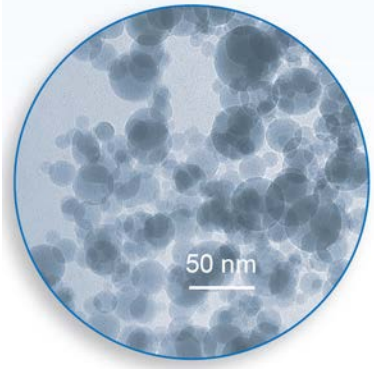
HfO_2

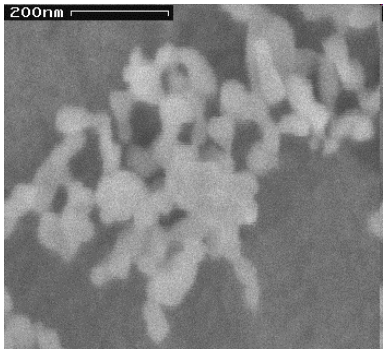
$1\%Nd:Y_2O_3$

Annealing 1000 ºC/3 h

Mixing

Uniaxial pressing (133-200 MPa)



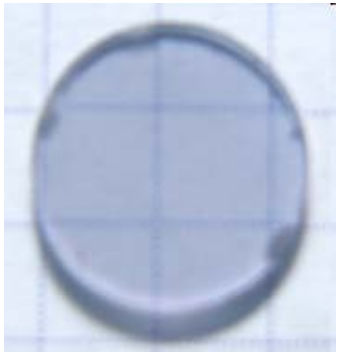


Vacuum sintering 1900 ºC/20 h

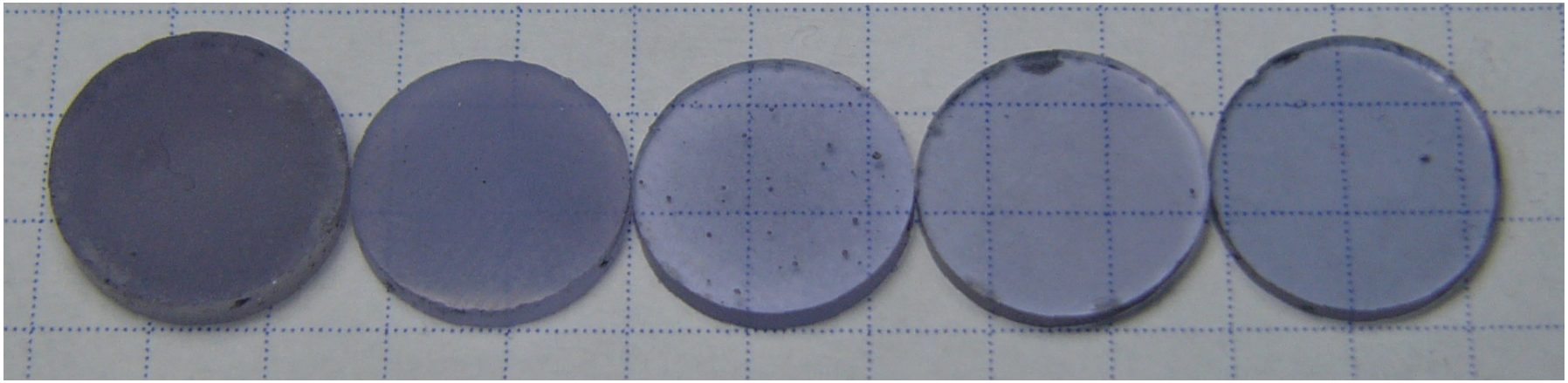
Annealing

Optical polishing

$Nd:Y_2O_3$ - HfO_2 ceramics

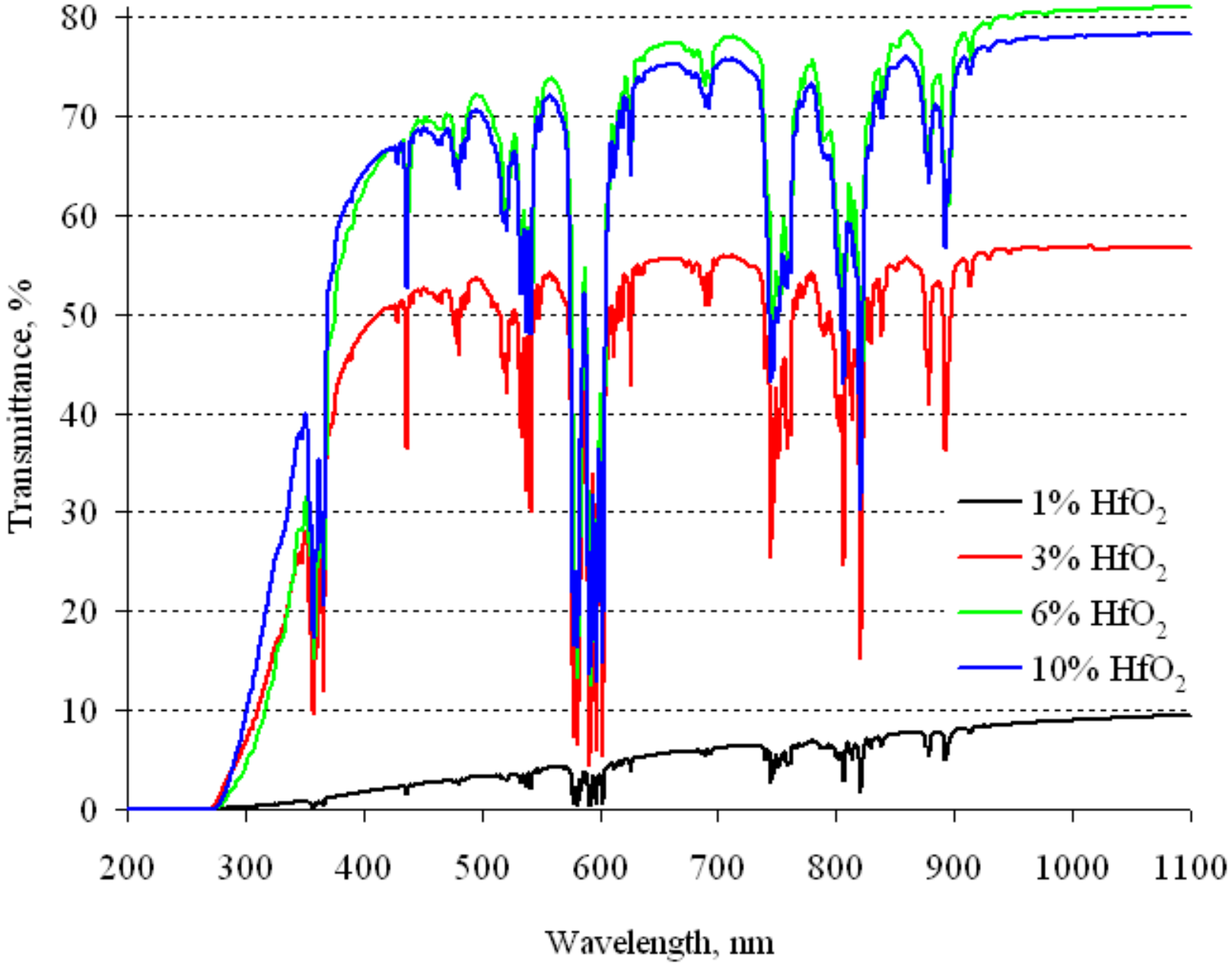


The photo of fabricated samples

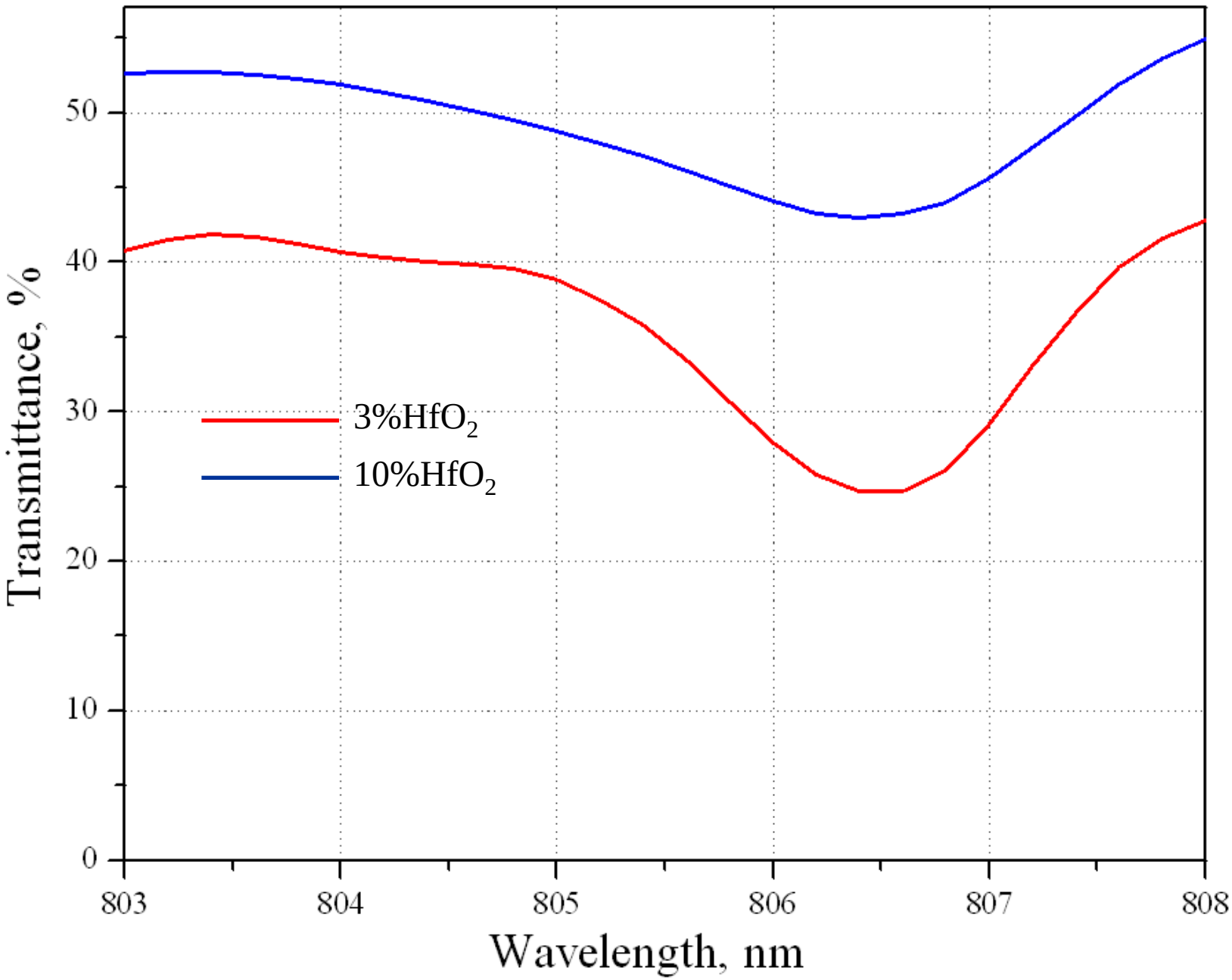


0% HfO_2 **1% HfO_2** **3% HfO_2** **6% HfO_2** **10% HfO_2**

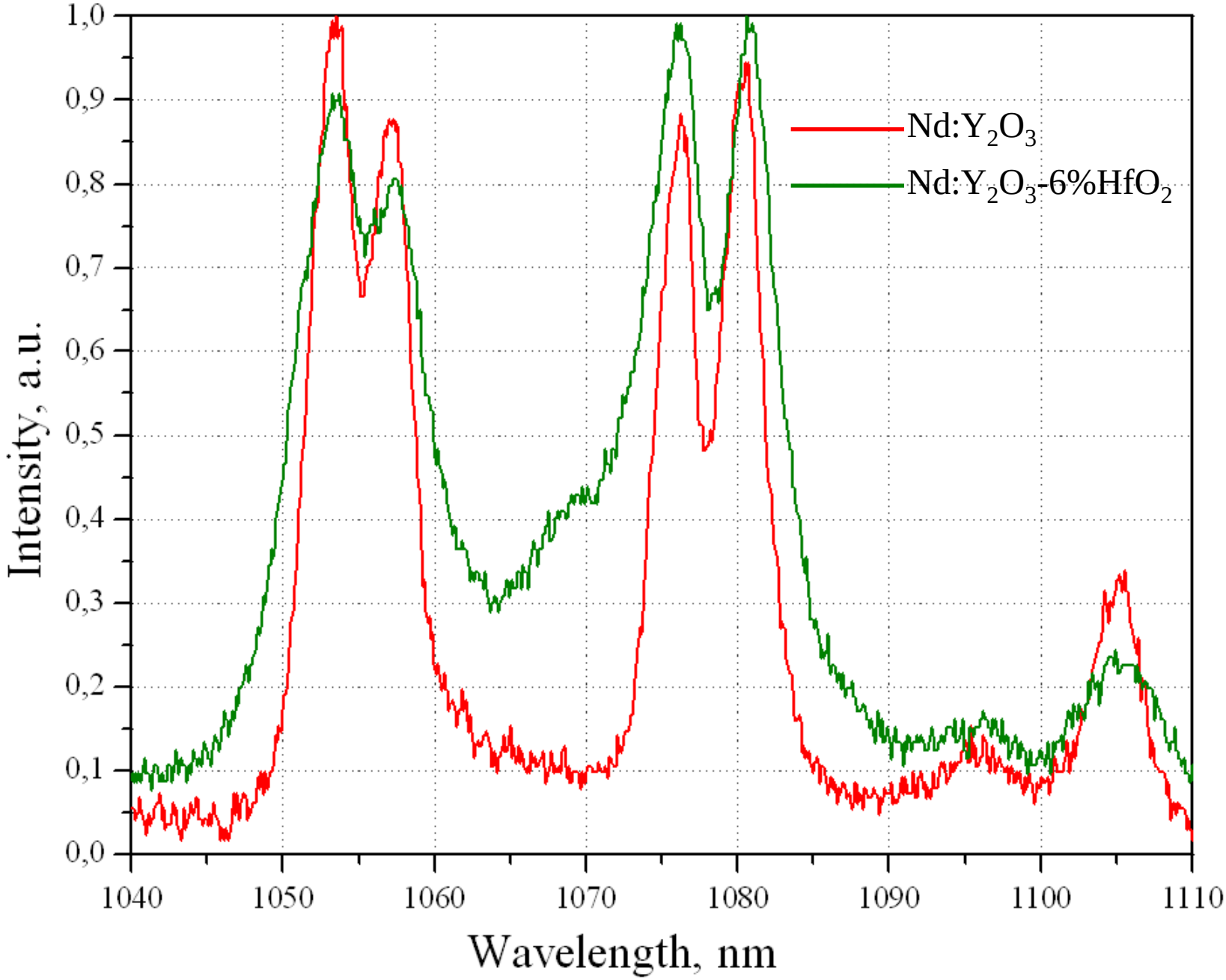
Transmission spectra of Nd:Y_2O_3 - HfO_2 ceramics



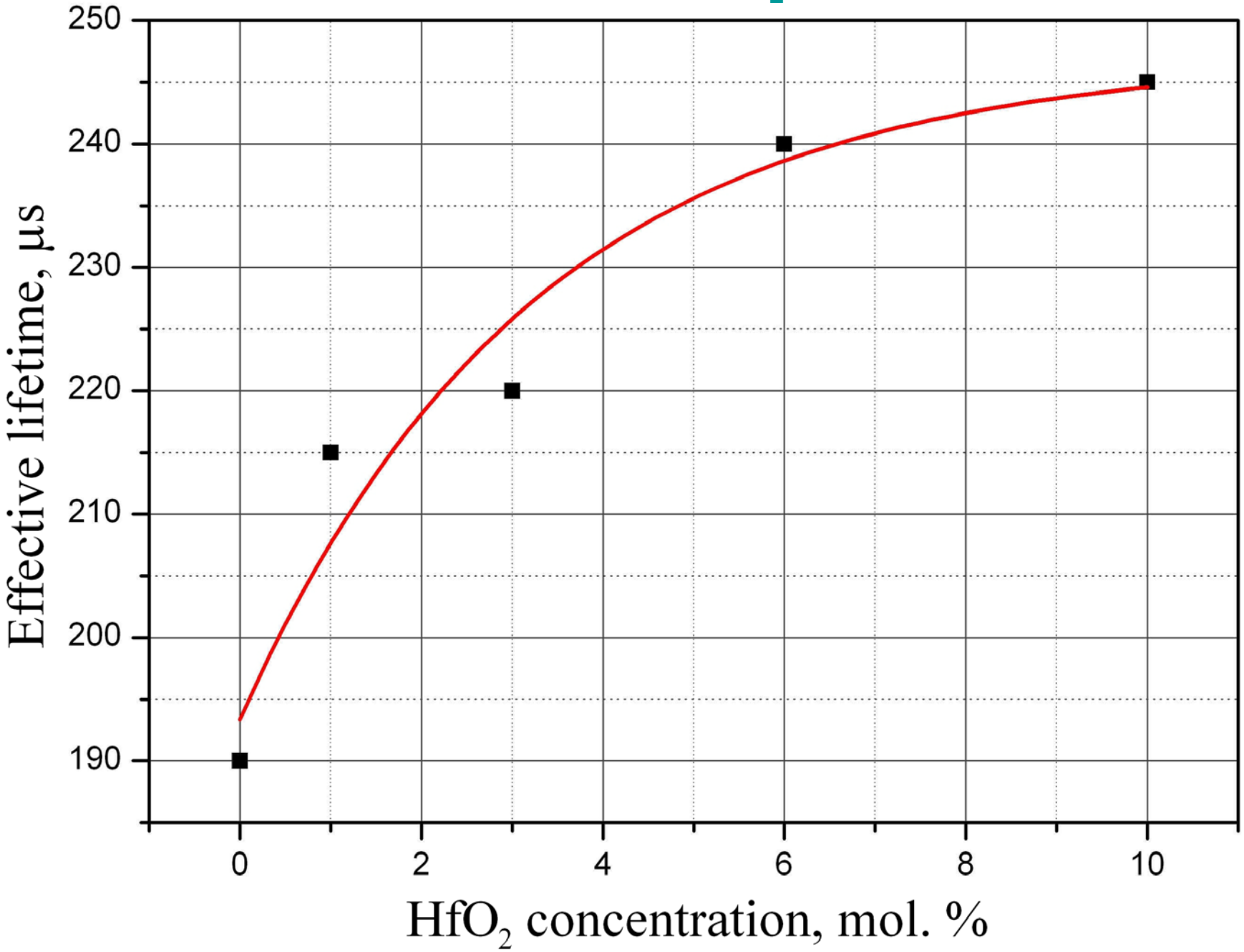
Transmission spectra at 803 – 808 nm



Emission spectra of undoped and 6 mol. % HfO_2 doped ceramics



Effective lifetime versus HfO_2 concentration



Conclusion

Summary

- Effective lifetime of Nd^{3+} ion grows with increase of HfO_2 concentration.

- Highest transparency was reached in 6 mol. % HfO_2 doped ceramics (80,96% at 1080 nm);

- Hafnium additives widen the emission and absorption bands of Nd:Y_2O_3 ceramics;

Future work

- Fabrication of Nd:Y_2O_3 ceramics using monoclinic nanopowder;

- Investigation of influence ZrO_2 (HfO_2) additives on optical properties of Yb:Y_2O_3 ceramics.