Luminescence Properties of Water-soluble Europium Complex at Different pH

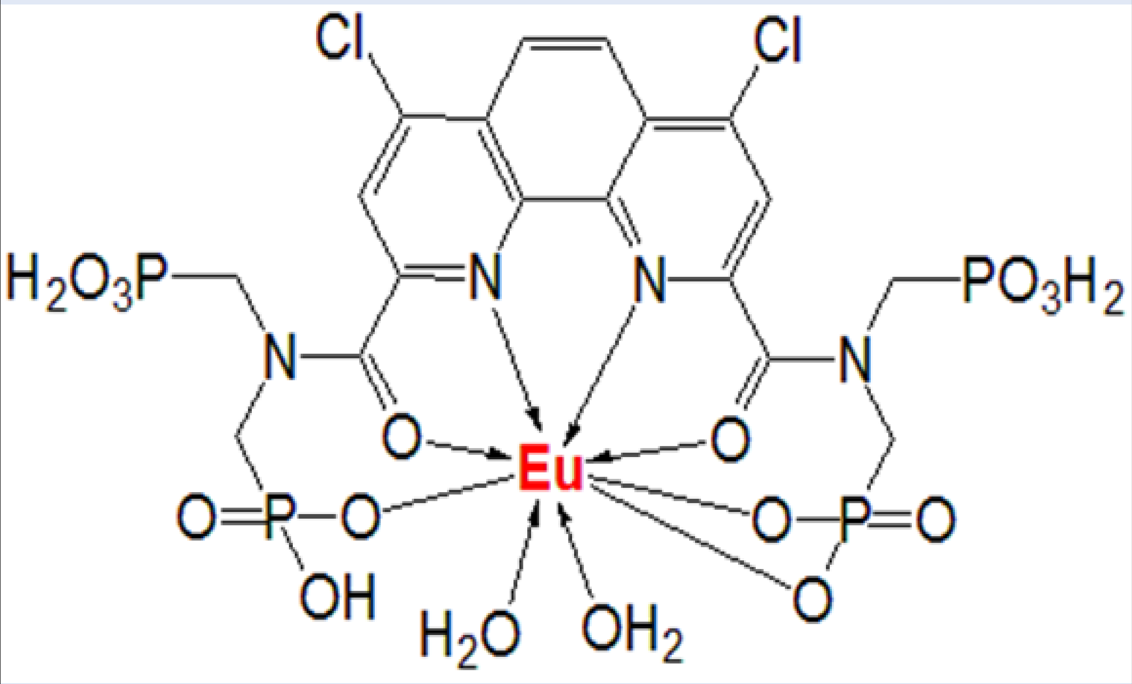
Charyshnikova Zinaida
Charyshnikova.za17@physics.msu.ru

INTRODUCTION

Changes in external conditions can have a significant impact on the luminescent properties of rare earth element complexes. The study of their luminescent characteristics at different pH values is a relevant task for the use of such compounds in medicine and biophysics. The substances used to determine the pH should have properties such as low exposure to the research object, fast response, and the ability to be used over a wide range of values. Europium complexes with organic ligands are potential candidates for use as pH sensors.

We researched the spectral-luminescent characteristics of the water-soluble europium complex based on 1,10-phenanthroline in a wide range of pH: from 0.50 to 10.08. We got the dependence of the emission spectra, luminescence quantum yield, lifetime, and asymmetry coefficient on pH.

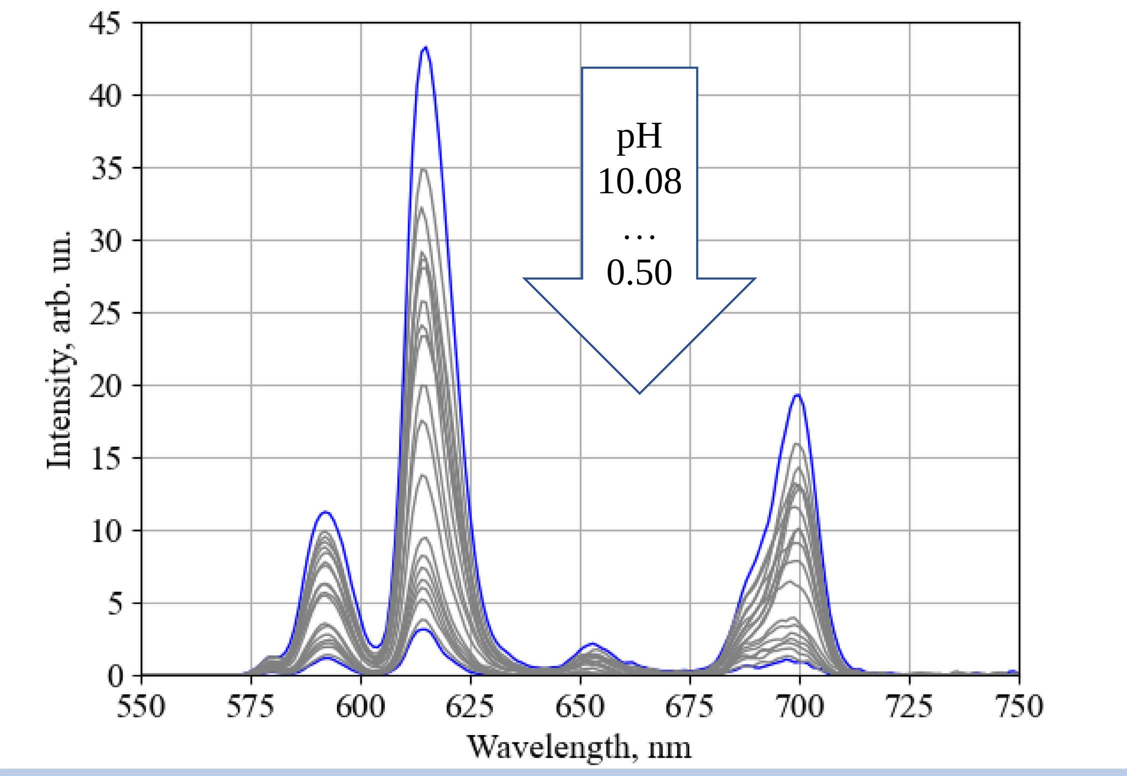
THE STUDIED EUROPIUM(III) COMPLEX



METHODS OF RESEARCH

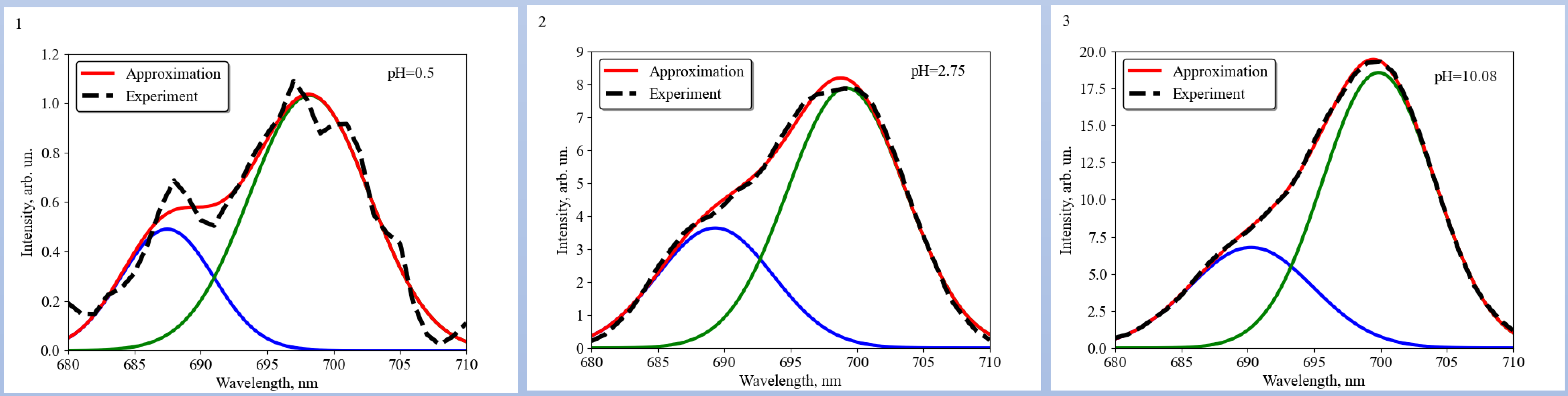
Solar PB2201 spectrophotometer was used to obtain the absorption spectra. The luminescence emission and excitation spectra, luminescence kinetics were recorded using a Solar CM2203 spectrometer.

EMISSION SPECTRA (λ_{ex}=320nm)

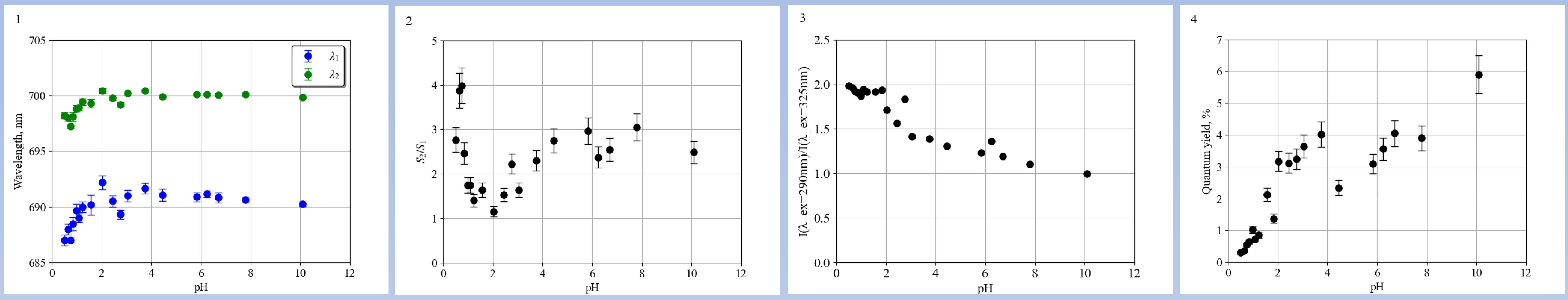


RESULTS

It was found that the quantum yield of luminescence increases linearly from 0.3% to 4.0% with an increase in pH from 0.50 to 3.74 and increases linearly from 2.3% to 5.9% with a change in pH from 4.44 to 10.08. Also, it is possible to determine the pH value by calculating the ratio of the luminescence intensities at the excitation wavelength of 290 nm to the luminescence intensity at the excitation wavelength of 325 nm. Besides that, we noticed that the luminescence band corresponding to the transition $^5D_0 \rightarrow {}^7F_4$ changed with pH value. We decomposed this band into two Gaussian components and determined the dependence of the maxima wavelengths on pH and the area ratio of these components on pH.



Decomposition of the luminescence band into two Gaussian components corresponding to the transition $^5D_0 \rightarrow {}^7F_4$:
1 – pH=0.5; **2** – pH=2.75; **3** – pH=10.08.



1 – Dependence of the maxima wavelengths of two Gaussian components on pH; **2** – Dependence of the area ratio of two Gaussian components on pH;
3 – Dependence of ratio of the luminescence intensities at the different excitation wavelength ; **4** – Dependence of the luminescence quantum yield on pH