To the Joint Doctoral Committee of VU and FTMC in the scientific field of Chemistry

Application for PhD studies topics contest

Research supervisor (pedagogical name, scientific degree, name, surname)
dr. Inga Morkvėnaitė-Vilkončienė

Title of PhD studies (topic)
The influence of toxicity and electric field on the viability of yeasts Saccharomyces cerevisiae

Topic description (no more than 1000 characters recommended, reveal the relevance, scientific novelty and perspective of the theme)

In this PhD project, yeasts Saccharomyces cerevisiae will be investigated by two important methods: electrochemical and mechanical after exposure with toxic materials and electric field. Electrochemical methods will be used to determine cells viability and cell wall permeability. Cells physical properties will be evaluated by mechanical dynamical characteristics, such as resonant frequency, stiffness and friction. These characteristics are very important in cell damage diagnosis. Interdisciplinary researches combining mechanics and biochemistry can give additional information about cells healthy and diseases. As powerful method in single cell researches two methods will be used for experimental research: SECM and AFM. Both of them can work in the cell’s natural environment, and evaluate single cells locally. Since SECM is equipped with ultramicroelectrode, it will be possible to detect the effect of low concentrations toxic materials. Additionally, SECM will be applied in order to expose the cells by electric field and register changes in cell viability immediately. To evaluate damage to the cell, the mathematical model will be created, which describes single cell and determine toxic materials and electric field influence on cells mechanical properties. The relation between cells biochemical and mechanical properties will allow to extend the knowledge about living cells, additionally, it is expected to create simple and fast methodology to determine cells viability.

Preconditions for successful completion of PhD studies (no more than 1000 characters recommended. Specify available equipment, mastered techniques, experience in solving similar tasks, preliminary studies.)

Yeast investigations by a Scanning Electrochemical Microscope (SECM) is a relatively new field of science: despite of the fact, that there are many studies in the world where the yeasts are measured by electrochemical methods, SECM studies are used rarely. Research on the mechanical properties of cells is performed using atomic force microscope (AFM) and mathematical models. Initial research on the modeling and mechanical properties of yeast cells has been performed in our laboratory. The results show that the electrochemical activity of yeast cells is related to their mechanical properties. Latest publications on yeast research by SECM are published by I. Morkvėnaitė-Vilkončienė with co-authors. The supervisor also has experience in AFM research, even modifying the AFM itself and adapting it to a variety of tasks. Thus, the prerequisites for successful work are as follows: the supervisor has the necessary
experience working with this type of cells and she is an expert in SECM and AFM; determining of the required conditions for SECM measurements is easy with conventional electrochemical techniques; the necessary equipment is at the Open Access Center.

**Positions held by the supervisor.**
(Please also indicate your position in other workplaces)

FTMC senior researcher, senior researcher at VU Faculty of Chemistry and Geosciences, associate professor at VGTU.

**The most important scientific publications of supervisor over the past 5 years:**


9. **Morkvenaite-Vilkonciene, I.,** Ramanaviciene, A., and Ramanavicius, A., *9,10-Phenanthrenequinone as a redox mediator for the imaging of yeast cells by...


**I have (not) supervised PhD students unsuccessfully:**
(Please indicate all PhD students who have not finished doctoral studies in the last 5 years or who have not received doctoral degree and explain the reasons.)

I have not supervised PhD students unsuccessfully.

Ingas Morkvenaitë-Vilkončienë

Name, last name, signature

2019.03.06

Date

**Approval of proposed topic**
I approve the topic of PhD studies applied for the contest

Head of Department of Electrochemical material science Rimantas Ramanauskas

(Head of FTMC Department, in which the PhD studies will be carried out)

Date 2019.03.06

Signature ...