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NUMERICAL SIMULATION OF OPTICAL RADIATION ABSORPTION BY DIELECTRIC MICROCAPSULES OF DIFFERENT SPATIAL SHAPES

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The heating dynamics a micron sized two layer capsules simulating transport microcontainers with water-containing load and light absorbing composite shell exposed to a near IR laser pulse (wavelength 800 nm) is theoretically studied. Both single microcapsules and the microassemblies of particles with various spatial shapes and different packing densities are considered. Using FDTD and FEM calculations, the numerical simulations of the optical field distribution inside and near the microcapsules are carried out, and the temporal dynamics of the temperature profiles of microparticles shells is obtained.

Based on the simulation results, one can conclude that the particle morphology introduces specificity in the spatial profile of the optical field and the distribution of light absorption regions. Variation in the geometric shape of a capsule leads to dramatic changes in the distribution of absorbed light energy and, accordingly, particle temperature field. In order to increase the efficiency of absorption of optical radiation in capsule volume and to obtain the maximum heating of absorbing shells, the capsules of cubic, cylindrical and partly rectangular shapes are preferable. Thus, having a 100-fs laser pulse with energy of only 20 μJ it becomes possible to heat a cylindrical microcapsule to the temperature of thermal destruction of its polymeric shell (~ 410 K). Worthwhile notice, the water filling of a capsule core remains cold. At the same conditions, the ellipsoid-shaped capsule is heated to multiple lower temperatures (~ 340 K).

G-9

APPLICATION OF MACHINE LEARNING ALGORITHMS AND LASER ABSORPTION SPECTROSCOPY TO SOLVE THE PROBLEM OF DETERMINING COMPONENTS WITH A LOW CONCENTRATION IN MULTICOMPONENT GAS MIXTURES

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Laser absorption spectroscopy is a promising tool in the field of component analysis of gas mixtures due to the presence of unique absorption lines of gases in certain frequency ranges. The main advantage of this technology is the ability to analyze the results using computer technology in real time, as opposed to analysis in chemical laboratories. Real time monitoring is the goal in environmental monitoring tasks. In the medical field, rapid analysis of results allows the creation of screening testing systems, and the ability to take an unlimited number of breath samples from the patient is an advantage over, for example, a blood test.

For the component analysis of gas mixtures, we have previously developed several machine learning models. Various algorithms were used: principal component analysis, support vector machine, artificial neural networks. All of them coped with the task with varying degrees of accuracy, but even our best model is not yet able to accurately determine the concentration of the smallest component in all cases, if the difference in concentration between the smallest and largest is several orders of magnitude, in some cases the error in determining the concentration reached 200%. Given the nature of the samples analyzed, large differences in the concentrations of the individual components are common. In this paper, we used a modified algebraic reconstruction technique to solve the problem of improving the accuracy of the results of the component analysis model.

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FLUORESCENT INDICES OF PLANTS LEAVES TREATED WITH GROWTH REGULATORS

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At the present stage of development of agricultural production, plant growth regulators have become an attribute of intensive technologies. However, most recommendations for their use, as a rule, lack data on their effect on the structural and functional characteristics of the photosynthetic apparatus. In this work, we investigated the slow fluorescence induction (SFI) of plant leaves (beans, cucumber), the leaves and seeds of which were treated with the preparation "Epin-Extra" (NEST-M company, active substance – 24-epibrassinolide). The fluorescence was excited by blue light, and recorded at a wavelength of 686 nm. The ratio $(F_M–F_T)/F_T$ (F_M – maximum, F_T – stationary value of the fluorescence intensity reached after 8–10 minutes of illumination) was used as the SFI parameter. Previously, it was shown that the relative changes in this indicator correspond to the relative changes in photosynthetic activity per chlorophyll.

Soaking of beans and cucumber seeds in a solution of the preparation (epibrassinolide content of 0.02 mg / l) led to an increase in the values $(F_M–F_T)/F_T$ compared to the control. As the soaking time increased, the values $(F_M–F_T)/F_T$ increased, and plant growth accelerated. The increase in the values $(F_M–F_T)/F_T$ after treatment of plants with epin-extra should be interpreted as a partial "removal" of non photochemical quenching due, for example, to a more active synthesis of ATP in the first seconds of illumination. At a lower (0.01 mg/l) and higher (0.04 mg/l) content of epibrassinolide in the epin-extra solution, the stimulating effect of the preparation decreased. Spraying of bean sprouts with epin-extra also led to an increase in the values $(F_M–F_T)/F_T$; a similar effect was observed within one week after spraying.

Thus, the SFI method can be used to evaluate the optimal consumption rates of drugs used in practice in terms of their stimulating effect on the photosynthetic apparatus. Subsequently, this approach was successfully used by us in field and vegetation experiments with cereals.

G-11

CHOOSING AN OPTIMAL SET OF INFORMATIVE FEATURES IN IR SPECTRAL DATA WHILE RETAINING A CLEAR DISTINCTION BETWEEN CLASSES RECOGNIZED

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There are many approaches to the problem of choosing the optimal set of informative features when analyzing multidimensional data. However, small sample sizes and the presence of a correlation between features lead to the fact that sets of informative features depend on random initial conditions, which does not allow making statistically significant conclusions about their importance.

This paper presents a different approaches for choosing an optimal set of features and shows the dependence of the results of using teaching methods on the number of selected features. Model IR spectra based on the HITRAN database were used as data.