Biophysical Reviews (2023) 15:1425–1861
https://doi.org/10.1007/s12551-023-01150-w

ABSTRACT

The 7th Congress of Biophysicists of Russia - conference proceedings

Abstracts

Published online: 11 October 2023

Thus, the manifestation of the action of an electric field of alternating voltage on barley seeds manifests itself immediately after the contact of seeds with moisture, a cascade of physiological and biochemical processes is launched at a higher level, which leads to an increase in yield.

S11.761. Mobility of upconversion nanosensors NaF4Yb,Er in the body of a terrestrial snail

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We report the results of a study focused on the mobility of NaYF4: Yb, Er nanoparticles (NPs) injected into a snail as a colloidal solution (0.2 ml, dosage 600 mg/kg). Hydro- and solvothermal methods allowed us to synthesize HPs in the form of nanorods up to 1 micron in length. They exhibited bright upconversion luminescence upon laser excitation at a wavelength of 980 nm. We analyzed the distribution of NPs in the organs of the snail, as well as the rate of their natural excretion. The idea of using various nanosensors for research, control and therapy in biology and medicine is now rapidly developing. One of the promising field is fluorescent nanosensorics, when the fluorescence response is excited by an external light source. UV radiation, which is commonly used for excitation, negatively effects on biological objects. Its strong absorption leads to photodestruction of biomolecules and heating of tissues. In addition, there is an intense scattering of UV radiation by tissues and autofluorescence of proteins, which adversely affects the accuracy of the method. In this work, we are testing the possibility of using upconversion nanoparticles (NPs) NaYF4: Yb, Er as fluorescent nanoprobes. Such NPs exhibit bright green luminescence upon excitation by a laser at a wavelength of 980 nm, which is in the "transparency window" of biological tissues. The use of such upconversion excitation makes it possible to completely avoid the problems with UV radiation described above.

Hydro- and solvothermal methods described in [1–3] were used in the synthesis. Then, the synthesized NPs were purified from by-products and coated with a silicone shell to protect the NPs from the undesirable effects of surface luminescence quenchers in the biomedium and impart hydrophilic properties to the NPs. We studied of the mobility of NPs injected into the body of the snail. Aqueous colloidal solutions of NPs injected into the internal cavity through the region of the sinus node of the snail (with no pain receptors). Then the behavior of the snail had been monitored for seven days together with the collection of excreted excrements. After that, we prepared the samples containing several organs of the snail and collected excrement according to the following method. The organic components of the preparations annealed at a temperature of 500°C for several minutes. The obtained ashes dissolved in 0.06 N hydrochloric acid and washed twice with water. These procedures yielded an unburned and insoluble precipitates. These studies provided information on the mobility of injected NPs into the body of the snail, the rate of their natural excretion from the body of the snail, and residual localization in organs seven days after injection. The report raises questions about the future prospects of using this type of upconversion NPs in biological applications (bioimaging, remote temperature measurement, etc.). Dependences of the mobility of NPs on their shape and size, as well as issues of toxicity, are shortly discussed.

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S11.762. Noise suppression in electronic absorption spectra of proteins by non-uniform rational B-splines

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Molecular absorption spectra of proteins are characterized, as a rule, by wide poorly resolved and often overlapping bands of absorption. This is because besides electronic levels of potential energy, molecules, unlike individual atoms, are characterized by the presence of additional vibrational and rotational levels with lower quantization values relative to electronic ones. Unquantized shifts in potential energy levels due to thermal and Doppler effects lead to the broadening of these bands and the formation of an almost continuous absorption spectrum. This circumstance makes it very difficult to correlate the peaks of the light absorption bands with the electronic transitions that form them.

The use of the technique of quasilinear Shpol'skii spectra, matrix isolation of molecules in inert gases, and low-temperature selective laser spectroscopy, although partially solving this problem, also has several methodological limitations. Another way to increase the resolving power in molecular absorption spectra was the use of derivative spectrophotometry [1]. There are also limitations here: numerical differentiation artifacts, false satellite peaks, and deterioration of the signal-to-noise ratio with increasing order of the derivative of the analyzed spectrum.

The best-known ways to reduce noise in light absorption spectra are increasing the integration time when measuring the signal, accumulation of absorption spectra and their subsequent averaging, use of smoothing algorithms based on a moving average, various linear, nonlinear, recursive and nonrecursive filters, as well as filters using Fourier and wavelet transforms, etc. [2-3]. Among smoothing filters with minimization of quadratic error in spectroscopy the Savitzky-Golay polynomial filter which in essence is an evolution of a moving average method is most often applied.

We propose to perform noise filtering using non-uniform rational B-splines, also known as NURBS curves. Being, in fact, a smoothing approximation, this spline can be used for low-frequency filtering of initial experimental data with their subsequent differentiation. If the Savitzky-Golay filter is set by parameters of the smoothing window width, the approximating polynomial order, and the number of successive passes of this filter, then NURBS-smoothing is determined by the number of control points, the order of the spline as well as by the number of successive approximations of the spectrum. Controlling the number of control points, which are the absorption spectrum measurement data, the order of the approximating spline function and the number of successive approximations, we can find the solution that best meets the signal/noise ratio (S/N).

On the absorption spectra of hemoglobin and albumin, we have demonstrated the possibility of using NURBS as a method of noise suppression in the light absorption spectra of proteins. It was shown that the method of smoothing using NURBS curves successfully competes with the Savitzky-Golay window smoothing method. However, it should be noted that the selection of optimal parameter values for one or another smoothing method requires some a priori knowledge about the spectral properties of the chromophores under study, in particular proteins. This makes it possible to minimize the interpretation errors of poorly resolved absorption bands. At the same time, the proposed method of noise filtering using NURBS requires further investigation to evaluate its advantages and disadvantages with respect to already used methods in terms of spectral data analysis [4-5].

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