

Electrochemical enzyme-free urea

A.N. Kozitsina

Ural State

62 8th March Street

E-mail: kan@usue.ru



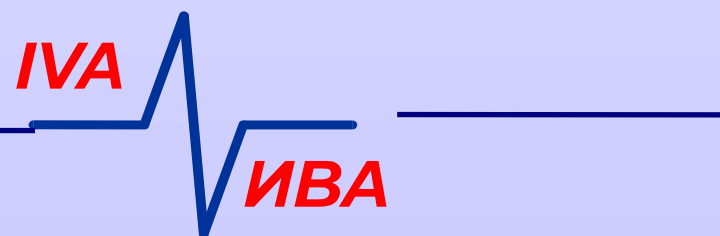
sensor for Clinical Analysis

M.S. Oslina

University of Economy

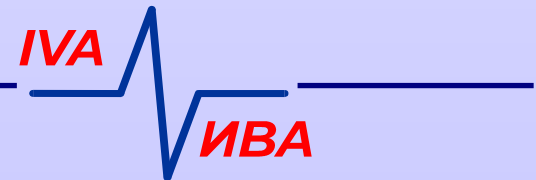
620219 Ekaterinburg (Russian Fed.)

kan@usue.ru



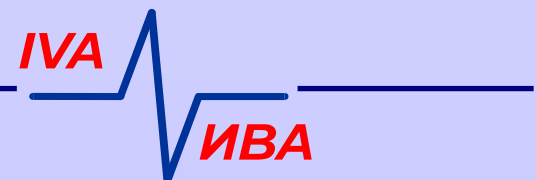
Determination of the urea concentration has acquired great significance in the clinic of internal diseases for diagnosis of renal abnormalities. The problem of evaluating the hemodialysis efficiency (which is judged by the urea concentration of the dialysis liquid) is very topical. Important parameters are the variation dynamics of the urea concentration during the procedure and the level of urea in blood serum before and after dialysis.

The urea concentration is most frequently determined using a catalytic reaction with urease and subsequent measurement of the concentration of ammonium ions. An advantage of such sensors is their high selectivity. However, time instability of the enzyme and the need of a substrate invoke difficulties in the use and storage of the sensors.

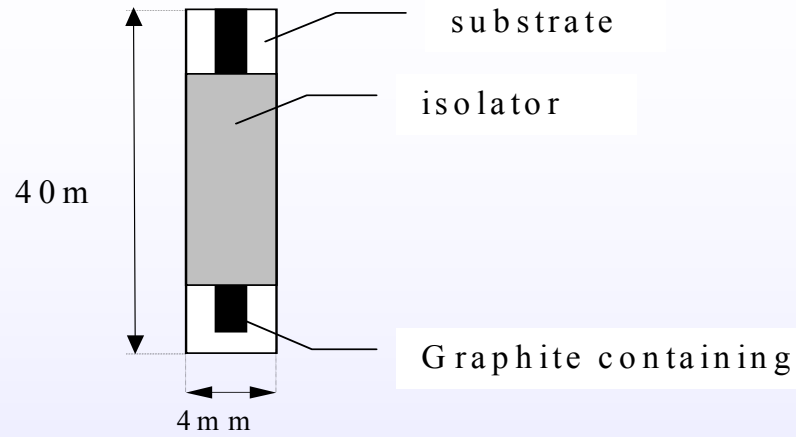


We proposed a new electrochemical sensor for determination of urea in biological materials. This sensor is free of an enzyme (urease) and is based on a solid-state catalytic reaction.

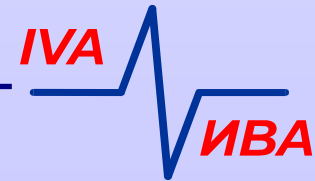
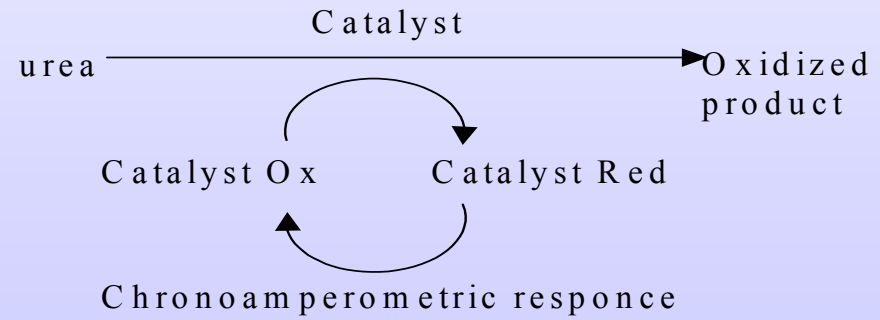
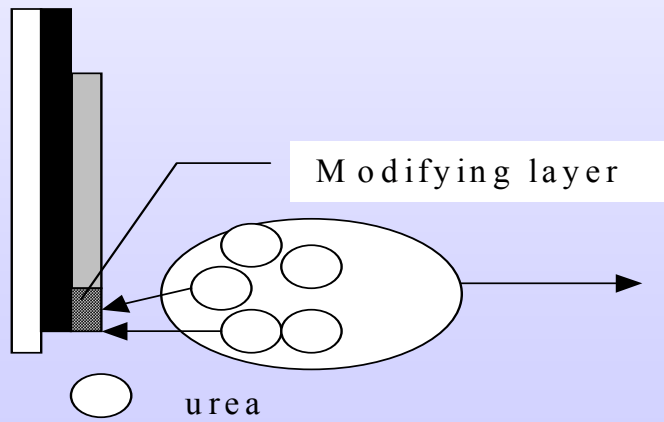
Electrodes made by the thick-film technology served as transducers. Graphite-containing ink (TUE) comprised the electroconductive layer. The graphite-containing layer was modified by adding an organic solution of the transducer into the volume of the graphite-containing compound. The organic solution of the transducer included an insoluble modifier and was free of urease. It was prepared by extraction or dissolution in an organic solvent. To eliminate the effect of interfering compounds present in biological materials, blood serum or dialysate (the object) was passed through an anion-exchange column and then was placed in the cell. The detection limit was 0.008 mM, while the correlation coefficient was 0.9998.



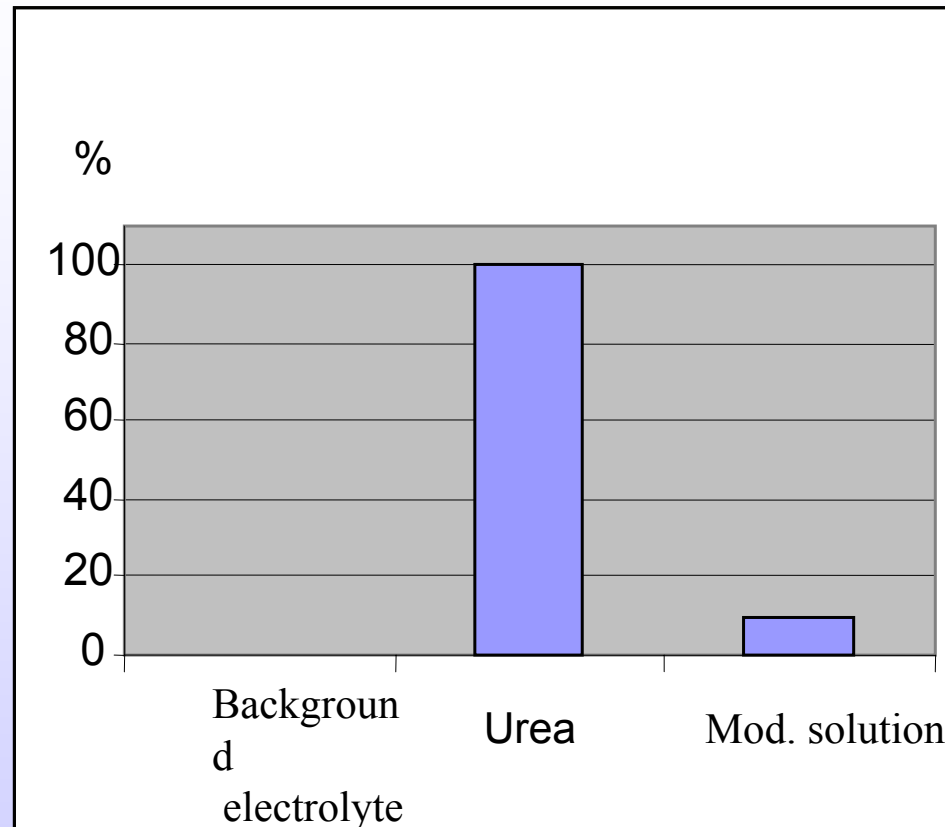
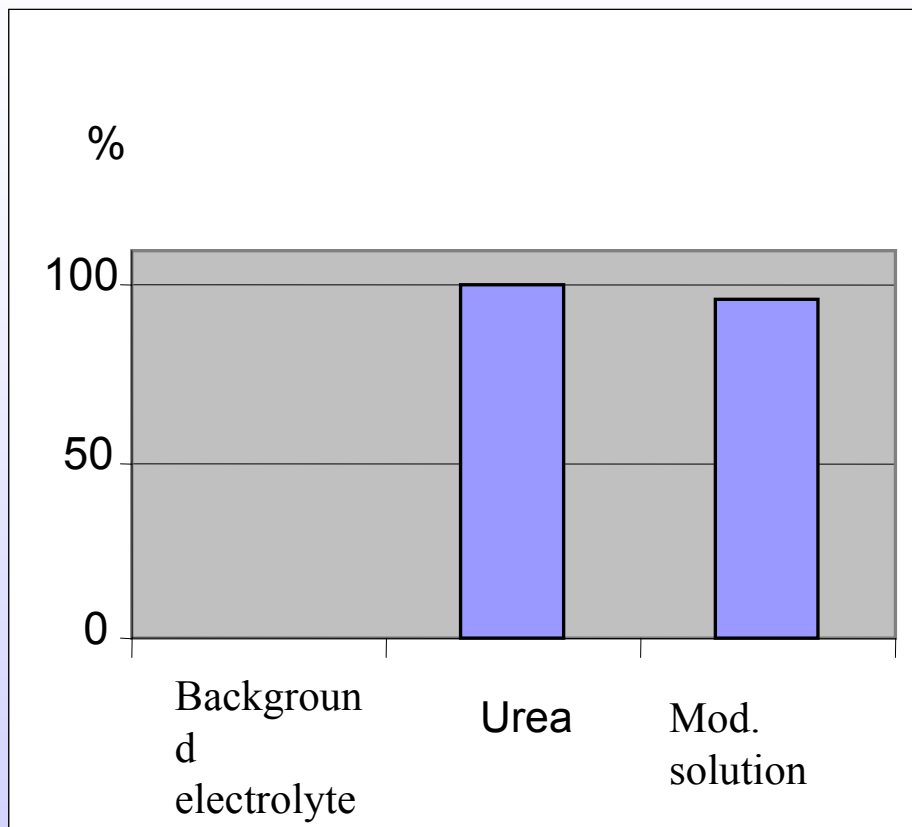
Thick Film Graphite Electrode



Sensor. Side view

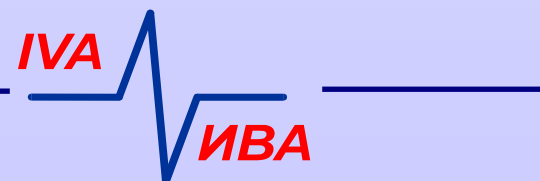


Results of determination of urea in modeling solution (a-before treatment; b-after treatment)

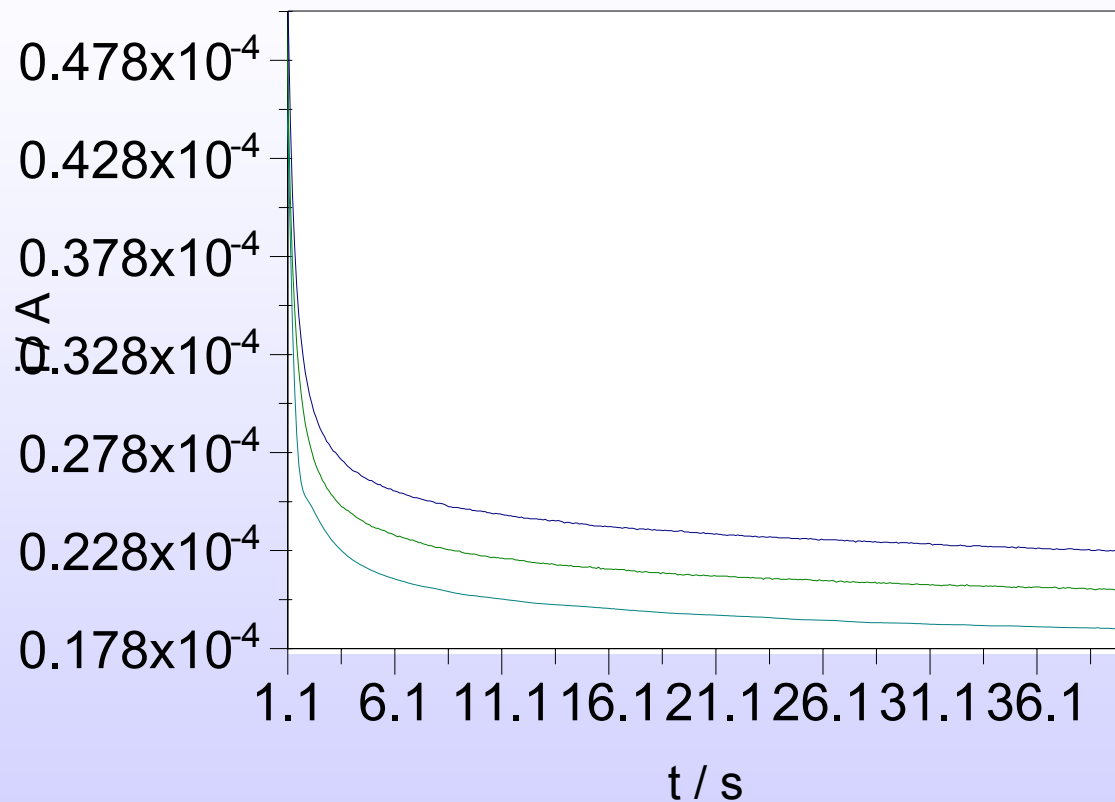


a

b



Chronoamperograms registered with the use of enzyme-free urea sensor



1 Background electrolyte
0,25M NaOH

2 urea 10^{-4} M

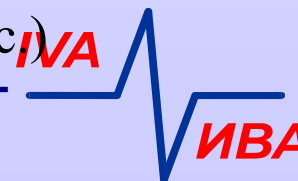
3 serum



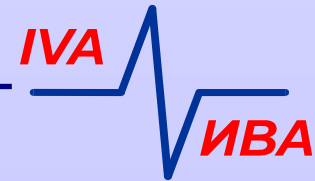
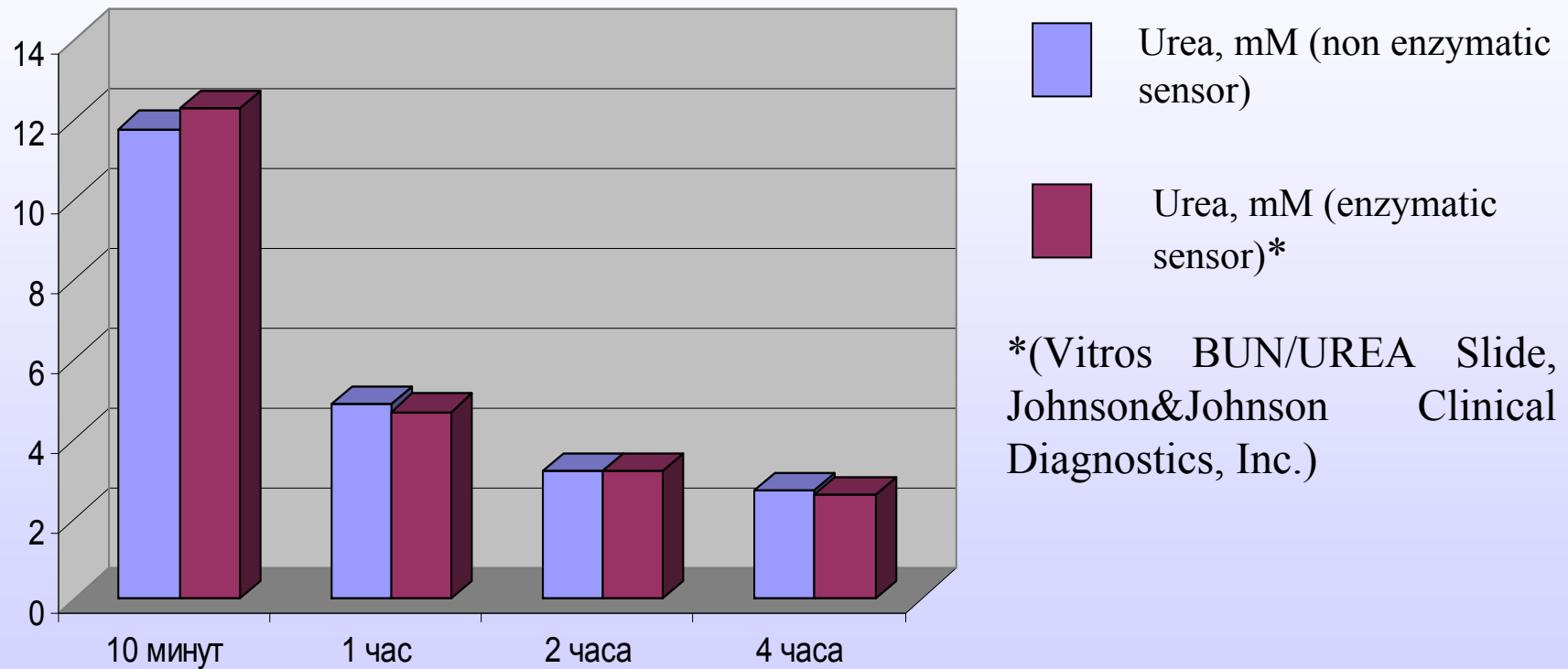
Comparative results of analysis of blood serum, which were obtained using an independent urease method and the proposed technique

| № | Urea, mM | |
|---|-------------------|----------------------|
| | Enzymatic sensor* | Non enzymatic sensor |
| 1 | 13,3±0,2 | 12,6±0,6 |
| 2 | 5,8±0,1 | 6,3±0,5 |
| 3 | 4,8±0,1 | 5,3±0,6 |
| 4 | 3,3±0,1 | 2,8±0,5 |
| 5 | 4,0±0,1 | 4,0±0,2 |
| 6 | 7,9±0,1 | 7,4±0,4 |
| 7 | 26,0±0,1 | 25,4±0,6 |

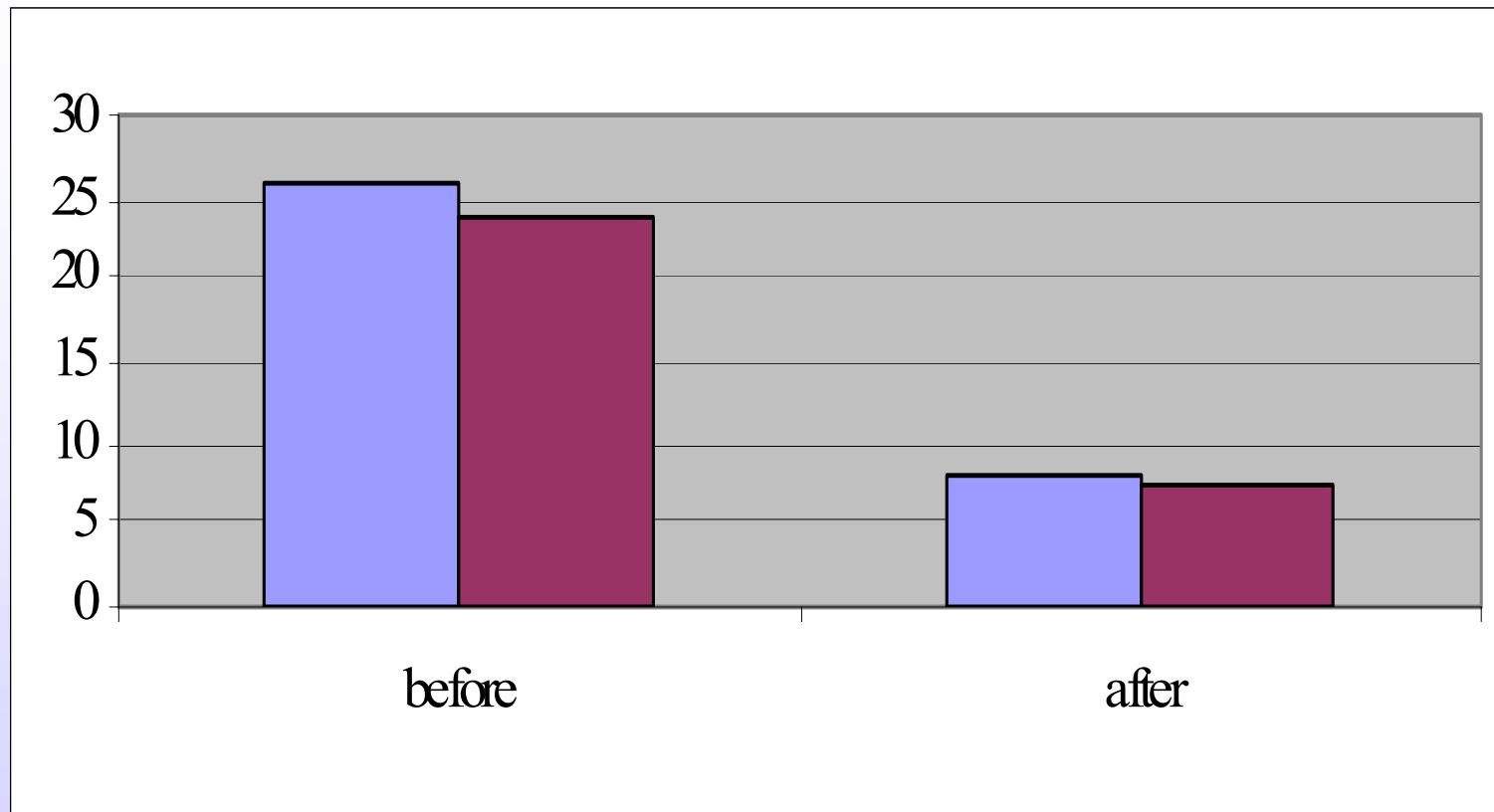
*(Vitros BUN/UREA Slide,
Johnson&Johnson Clinical Diagnostics, Inc)





Comparative results of analysis of the dialysis liquid of a patient, which were obtained by an independent urease method and the proposed technique



Urea concentration in serum before and after dialysis.



-  Urea, mM (enzymatic sensor)
-  Urea, mM (non enzymatic)

