

**Таблица 2 – Влияние методов подготовки и формирования серебряных покрытий на их функциональные свойства**

Вид обработки*	Форма тока	Микро твердость Нм, мН/м <sup>2</sup>	Износостойкость, W, 10 <sup>-6</sup> нм <sup>3</sup>	Контактное сопротивление, R <sub>к</sub> , мкОм
Механическое полирование	ПТ	940	4,11	29,3
	ИТ	4450	1,92	34,3
	РТ	1300	2,17	31,1
Химическое полирование	ПТ	870	4,62	17,3
	ИТ	1280	4,07	21,7
	РТ	1250	3,77	19,5
Электрохимическое полирование	ПТ	905	3,95	17,5
	ИТ	1310	3,28	20,9
	РТ	1260	2,90	19,7
Электролитно плазменная обработка	ПТ	910	2,11	14,3
	ИТ	1330	1,89	16,7
	РТ	1280	1,51	13,9

\*AgNO<sub>3</sub> – 40 г/л:  $i_k = 0,3 \text{ А/дм}^2$ ;  $i_k^{ITT} = 3 \text{ А/дм}^2$  (q = 10, f = 1 Гц)  $i_k^{PT} = 3 \text{ А/дм}^2$  (q = 10, f = 1 Гц,  $\frac{i_k}{i_a} = 5$ )

#### ЛИТЕРАТУРА

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#### ELECTROCOAGULATION OF FLUORIDE FOR CLEANING WATER

Electrocoagulation is used as an electrochemical water treatment whereby sacrificial anodes corrode to release active coagulant precursors (usually aluminum or iron cations) into solution. The accompanying electrolytic reactions evolve gas (e.g. hydrogen) at the cathode. Electrocoagula-

tion has a long history in research to remove water contaminants but is has never been accepted as a mainstream water treatment technology [1]. The new approach of the will overcome issues such as comparably high energy use, inefficient reactor design/operation and electrode reliability which until now prevented a sustainable large scale market transfer of electrocoagulation systems. Recently there is a growing need for small-scale decentralized and environmentally friendly water treatment facilities which is represented by the electrocoagulation [1].

In our work [2] for the removal of pollutants such as fluoride, phosphate and even heavy metals such as arsenic the system will be extended by using the process of electrocoagulation. The created cations later adsorb pollutants in the water and coagulate to large flocs. The flocculants/coagulants are subsequently removed mechanically by filtration. The maintenance of the unit is very simple. Compared to conventional treatment units a great reduction of waste material can be realized by deployment of an electrocoagulation unit which is potentially even applicable for waste water treatment. The reduction of waste material is possible because operating conditions and parameters can be adjusted in such a way that only the necessary amounts of reactants are generated at the electrode.

The main goal is the development of a solar powered unit for removal of fluoride, phosphate and other pollutants based on electrocoagulation [3, 4]. In other, people in many African regions without electricity have to use drinking water with pollution of fluoride from mining industry and agriculture every day. Therefore, our method of electrocoagulation for fluoride removal has to be developed to ensure the access of clean drinking water in these especially rural regions of Africa.

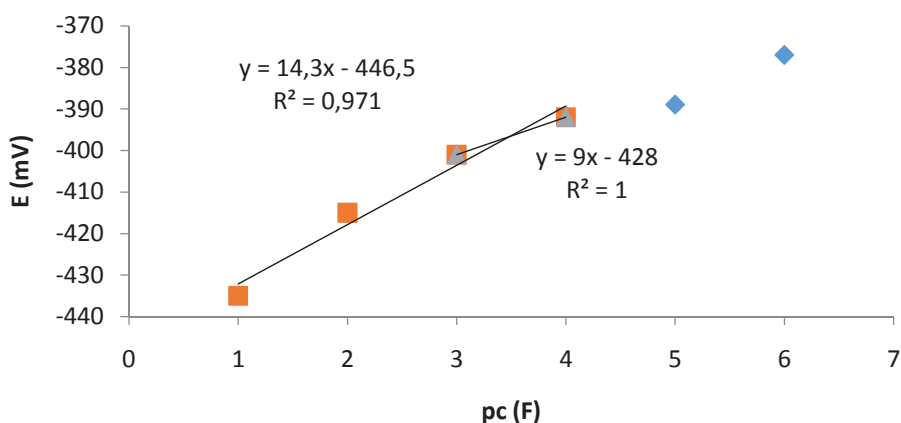
The electrocoagulation experiment took place twice. In both an electrolyte concentration of 2 g/l sodium chloride and 40 mg/l fluoride was used but the amount of the solutions was different. Within about 2 hours a system of graphite an iron electrodes were supplied with electrical power (15 mA). In regular intervals current and voltage were recorded and samples were taken (Tabl.1).

**Table 1 – Record of current, voltage and observations during electrocoagulation**

Time [min]	Voltage [mV]	Current [mA]	Observations
15	-227,7	15	5 min red/brown flocs
30	-249,9	15	
45	-371,2	14	40 min solutions green colored
60	-385,8	15	60 min solution dark green to blue
75	-528	14	90 min solution light blue
90	-531	14	
115	-528	13	
120	-526	13	

The iron anode showed its release of  $\text{Fe}^{3+}$  already after about 5 min. The testing solution turned into a green to blue color after about 40 minutes.

Analysis of fluoride concentration was carried out by potential measurement with using fluoride selective electrode. The calibration solution with different concentration of  $\text{F}^-$  (45 ml) were mixed with 5,0 ml EDTA buffer solution (Fig 1). As you can see in the calibration plot there are two possible calibration functions.



**Figure 1 – Calibration dependence of E(mV) on pc(F<sup>-</sup>) for fluoride selective electrode.**

Each probe (8,0 ml) after electrocoagulation was mixed with 5,0 ml EDTA buffer solution and diluted to 50,0 ml with distilled water (Tabl. 2.)

**Table 2 – Measurements of fluoride concentration and calculation with the two functions of fluoride selective electrode**

Sample	E [mV]	Y = 9x - 428				Y = 14,3x - 446,5
		pc (F)	c(F) [mol/l]	Dilution difference* c(F) [mol/l]	$\beta(\text{F})$ [mg/l]	$\beta(\text{F})$ [mg/l]
30 min	-401	3,0000	0,00100	0,005625	106,9	70,3
60 min	-397	3,444444	0,000359	0,00202152	38,4	36,9
90 min	-397	3,444444	0,000359	0,00202152	38,4	36,9
120 min	-397	3,444444	0,000359	0,00202152	38,4	36,9

\*45 ml (calibration)/8,0 ml (sample) = 5,625

As you can see from table 2 the analysis is too less sensitive. The recovery is higher than the actual concentration of fluoride after 30 min that can be caused by influence of  $\text{Fe}^{2+}$  ions in solutions. Nevertheless after 60 min electrocoagulation the increasing potential shows a decreasing concentration of fluoride to 36,9-38,4mg/l that shows the sorption of  $\text{F}^-$  ion on surface of large flocs which start to form only after 40 min electrocoagulation. However, if we continue electrocoagulation the concentration of fluoride does not change because the process of coagulation has finished until 60 min of electrolysis.

For electrocoagulation experiment, a decreasing concentration of the solution could be determined. Possible reasons could be the increased amount of used testing solution and incomplete oxidation of iron to  $\text{Fe}^{2+}$  (shown by the green to blue color of the solution after about 40 min). These conditions allow increasing the concentration of  $\text{Fe}^{2+}$ , their transfer to  $\text{Fe}^{3+}$  and formation of large flocs, finally, and it improve removing of  $\text{F}^-$  ion.

#### REFERENCES

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#### **THIN-LAYER CO-DOPED $\text{LiMn}_2\text{O}_4$ SPINEL COMPOSITE WITH CARBON NANOTUBES FOR LITHIUM-ION BATTERIES AT LOW TEMPERATURE**

With technical progress development the demand for high energy autonomous power sources particularly for lithium-ion batteries (LIB) increases. Success of LIB basic research and practice applications are regarded as conspicuous progress in the electrochemistry of last decades. However it is necessity in LIB improvement with aim of their cost decrease