

THE ROLE OF SILICON ADDITION AND MICROSTRUCTURE ON CORROSION
BEHAVIOUR OF STAINLESS STEELS IN CHLORIDE SOLUTIONS

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1. Introduction

Literature shows that influence of silicon addition to stainless steels depends of environment red-ox potential [36, 31]. In strongly oxidizing environments silicon increase corrosion resistance of stainless steels by formation of passive enriched in silicon oxide SiO₂ [34]. So far the is lack of research explaining influence of microstructure alloy on in corrosion behavior.

2. Experimental

The austenitic (316) and duplex austenitic-ferritic (324) stainless steel (chemical composition Tab.1) were introduced to the corrosion resistance test (linear sweep voltametry). Polarization curves were performed in 1% and 3% sodium chloride solution at 37°C. Surface of the raw and after corrosion test samples were analyzed using X-ray photoelectron spectroscopy (XPS).

Tab. 1. Chemical composition of S32404 stainless steel.

Grade	Content [wt.%]									
	Fe	Cr	Ni	Mn	Si	Mo	Cu	S	P	C
316	69,11	16,54	10,10	1,60	0,55	2,02	-	0,03	0,03	0,02
324	66,01	20,40	7,50	1,60	0,59	2,33	1,52	0,03	0,02	0,03

3. Results and discussion

3.1 Corrosion test

Figure 1 presents the polarization curves LSV of the steel surfaces in 1% 3% NaCl solution at 37°C. The tested steel belong to the corrosion resistant material. Steel undergo spontaneous passivation in chloride environments under stationary conditions. However, in tested chloride solutions at temperature higher than standart (37°C), show the tendency to pitting corrosion.

3.2 Surface composition

Table 2 demonstrates the element content on the raw and the treated surfaces, from the XPS

analyzes. It can be noticed that the surface composition after corrosion test differs significantly compared to the untested one. Especially high enrichment of silicon content for duplex stainless steel can be noticed.

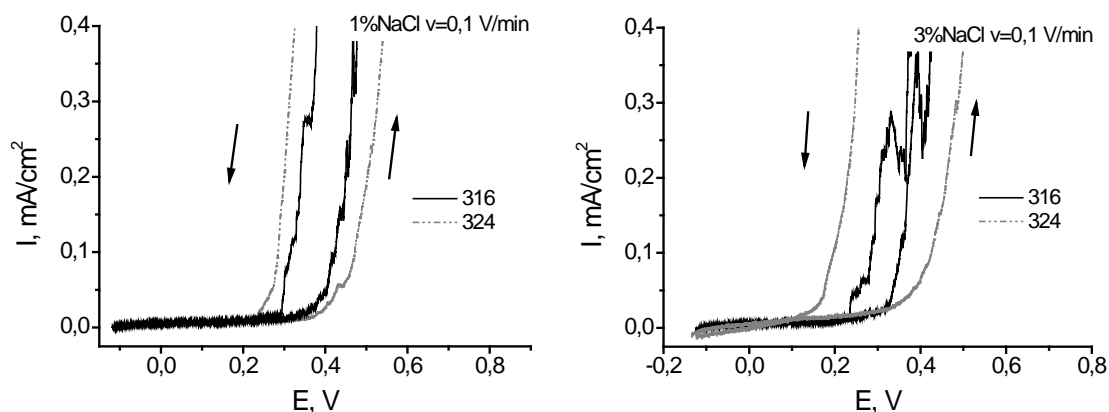


Fig. 1. LSV curves of the 316 and 324 stainless steel in: a) 1% NaCl; b) 3% NaCl,

Table.2. Chemical composition of the S32404 stainless steel surface before and after corrosion test, based on XPS analyzes

Stal	Stan	content, wt. %							
Grade	Surface	Fe	Cr	Ni	Mn	Mo	Si	C	O
316	Before corrosion test	7,6	4,6	0,7	1,4	-	-	47,4	38,3
	After corrosion test	1,4	3,2	-	-	-	2,4	63,1	29,9
324	Before corrosion test	8,7	7,9	0,8	1,8	0,6	-	36,4	43,9
	After corrosion test	2,4	3,6	-	0,4	-	6,3	51,9	35,4

4. Conclusions

The collected results evidence that after corrosion in chloride solutions at elevated temperature of 37°C high enrichment of the surface in silicon is observed especially for 324 stainless steel. It is related to the alloy additives and duplex austenitic –ferritic microstructure of the steel [4].

References

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