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# Study of the possible galvanic corrosion of several prosthetic alloys coupled with their usual post-solder in an artificial saliva

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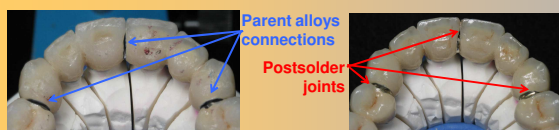
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Both parent alloy and its postsolder are exposed to the buccal milieu and this can lead to an exchange current between the two. Galvanic coupling experiments were performed over three days in an artificial saliva (Afnor norm). Corrosion potentials and polarization resistances were recorded. The measured values were analyzed by taking into account the EpH diagrams of the different elements belonging to the parent alloy and the postsolder alloy.

## Fixed partial denture and postsolder joint



Postceramic solders realized after ceramic baking are exposed to buccal milieu with a part of the connection of the framework

Alloys	Au	other precious		other metals	High Noble alloys (for which Au+Pt+Pd> 60%, Identallloy® norm)
dSIGN98	85.9	12.1Pt		2.0Zn	
Aq. Hard	86.1	8.5Pt 2.6Pd		1.4In	
dSIGN91	60.0	30.6Pd		1.0Ga 8.4In	
Lodestar	51.5	38.5Pd		1.5Ga 8.5In	
W	54.0	26.4Pd		15.5Ag1.5In2.5Sn	
dSIGN59	59.2Pd	27.9Ag		2.7In 8.2Sn 1.3Zn	Noble alloy
Alloys	Ni	Cr	Mo or W	Al or Si	Predominantly Base alloys (less than 25% Au+Pt+Pd.)
4ALL	61.4	25.7	11.0Mo	1.5Si	
Pisces Plus	61.5	22.0	11.2W	2.3Al 2.6Si	
Solders	Au	Ag	Cu or Zn	Ga or In	Postsolder for ...
.650	65.0	13	19.6Cu	2.0Ga	Aquarius Hard
.615	61.3	13.1	17.4Cu	7.6In	dSIGN91, dSIGN59, Lodestar
.585	58.5	16.0	18.0Cu	7.2Ga	dSIGN98
LFWG	56.1	27.4	15.8Zn	/	W, 4ALL, Pisces Plus

All alloys and solders were supplied by IVOCLAR VIVADENT

## Experimental Setup



Working electrode

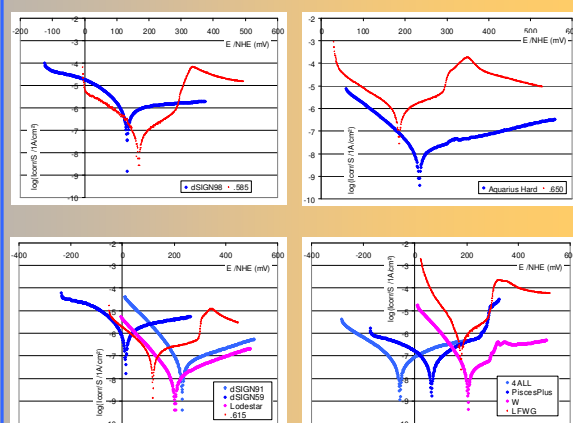
Electrochemical cell :  
three electrodes and galvanic coupling

## AFNOR SALIVA

Composition	Concentration (g/L)
NaCl	6.760
NaHCO <sub>3</sub>	1.500
KCl	1.200
KSCN	0.330
Na <sub>2</sub> HPO <sub>4</sub>	0.260
KH <sub>2</sub> PO <sub>4</sub>	0.200

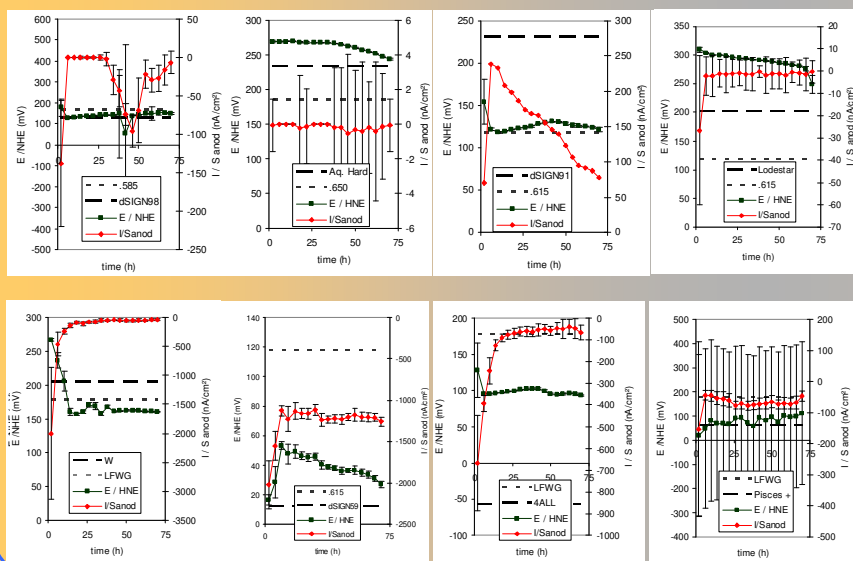
## Tafel curves of the twelve alloys:

In each graph the parent alloy(s) with its (their) postsolder alloy



- For postsolder alloys and W parent alloy : anodic peak near +300 mV/NHE, followed by the beginning of a passivation plateau.
- The other curves show anodic or cathodic parts which are curved lines.
- dSIGN91 and Lodestar: anodic and cathodic Tafel straight lines
- Oxygen dissolved in saliva, with a variable concentration, is effectively the principal oxidant present (confirmed by the values of the cathodic Tafel coefficient  $b_c$  which was often close to 60 mV/decade)

## Evolutions of the common potential and of the exchange current of the parent alloys coupled with their postsolders



Galvanic coupling	E <sub>corr</sub> during Tafel exp. (mV)			Galvanic corrosion			
	parent alloy	postsol. alloy	alloy with the lower E	E/NHE (mV) average	I (nA/cm²) average	anodic alloy	
dSIGN98 with .585	+132	+168	dSIGN98	+177 +151 +139	138 7 31	dSIGN98	
A. Hard with .650	+234	+186	.650	+270 +245 +263	0 0 0	Aquarius Hard	
dSIGN91 with .615	+231	+118	.615	+154 +122 +127	+70 +78 +148	.615	
Lodestar with .615	+202	+118	.615	+310 +249 +290	27 0 3	Lodestar	
W with LFWG	+205	+178	LFWG	+267 +161 +175	1999 42 202	W	
dSIGN59 with .615	+12	+118	dSIGN59	+17 +27 +38	2024 1258 1259	dSIGN59	
4ALL with LFWG	57	+178	4ALL	+128 +93 +99	667 66 126	4ALL	
P. Plus LFWG	+64	+178	Pisces Plus	+19 +110 +79	153 46 69	Pisces Plus	

Results of the galvanic coupling experiments and comparison with the potential hierarchy observed during the Tafel ones.

## CONCLUSION

Tafel experiments showed that the alloys belonging to a framework can display different electrochemical behaviours in an aerated solution simulating saliva. This difference of behaviour can lead to the existence of an exchange current which can rapidly decrease down to undetectable values, but which also can stay, in other cases (no noble alloy in electrical contact with a noble alloy), at a more significant level.