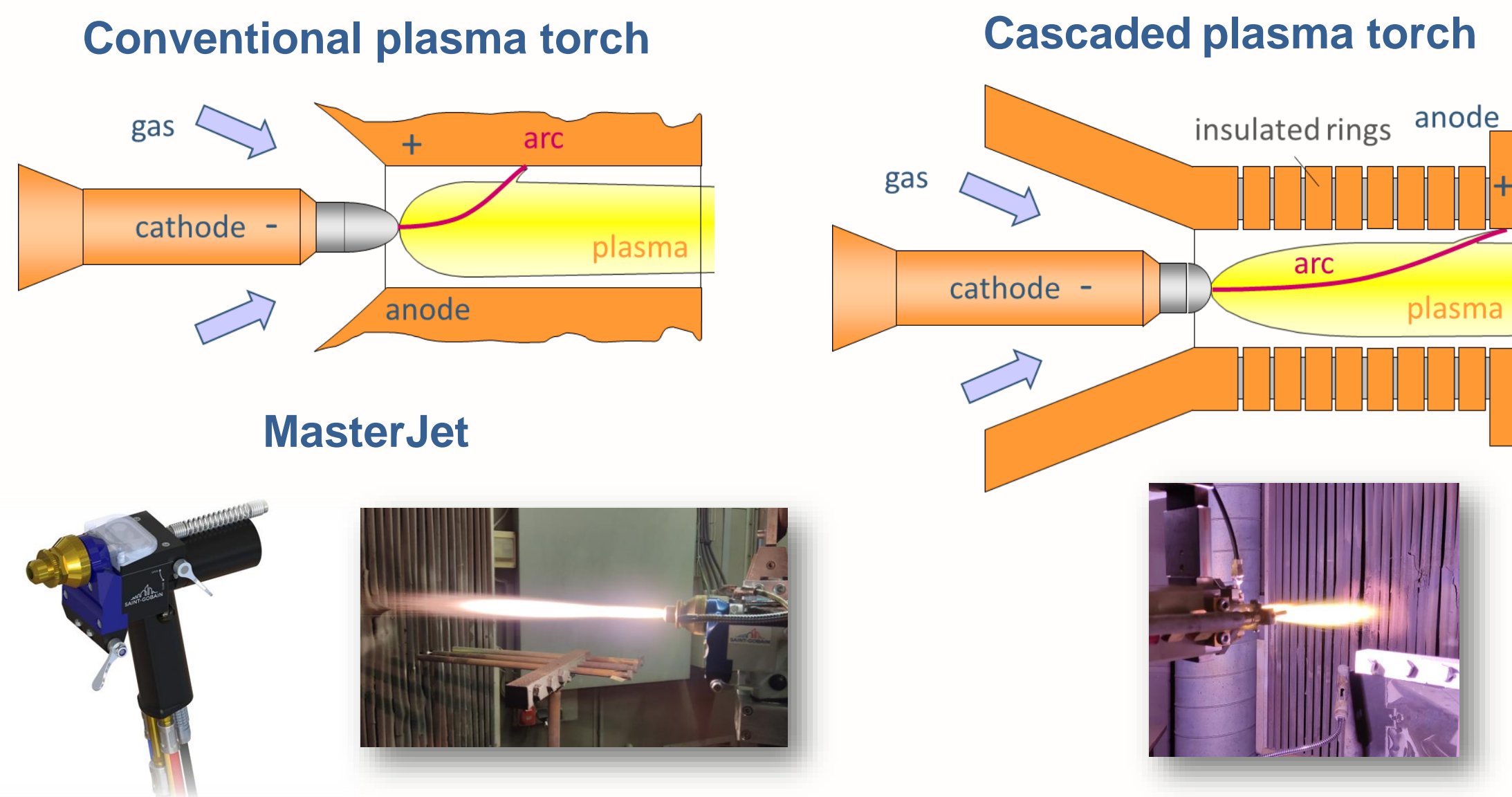


Comparison of Cr₂O₃ coatings obtained by different plasma and flame spraying processes: torch, particle and coating study

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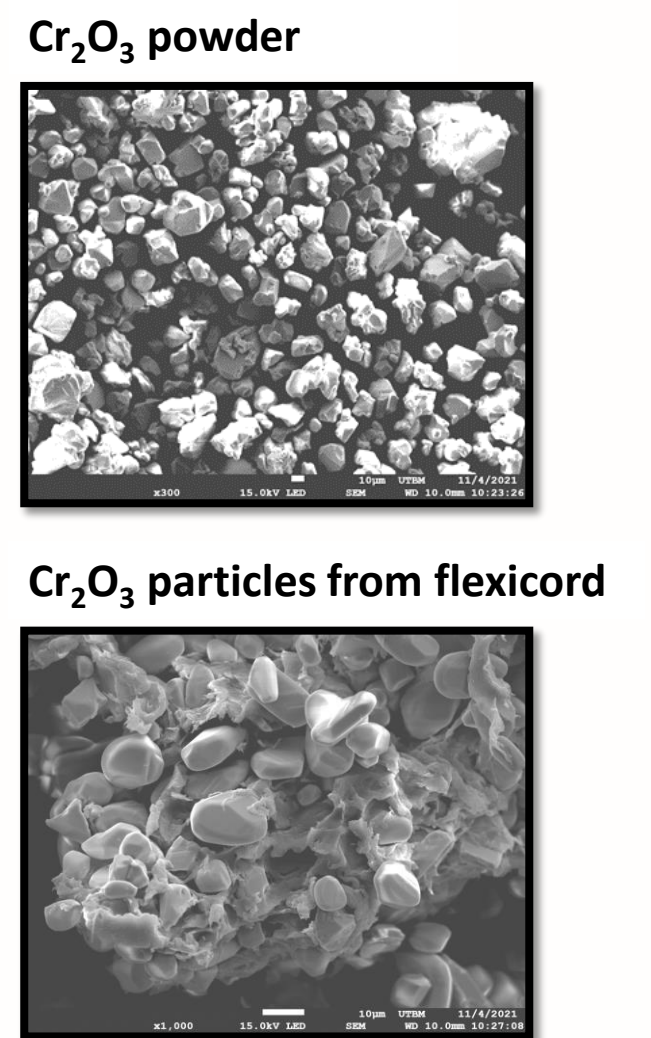
Objectives : focus on the development of Cr₂O₃ coatings with different plasma torches (conventional and cascaded configurations) to control and optimize the properties

Processes

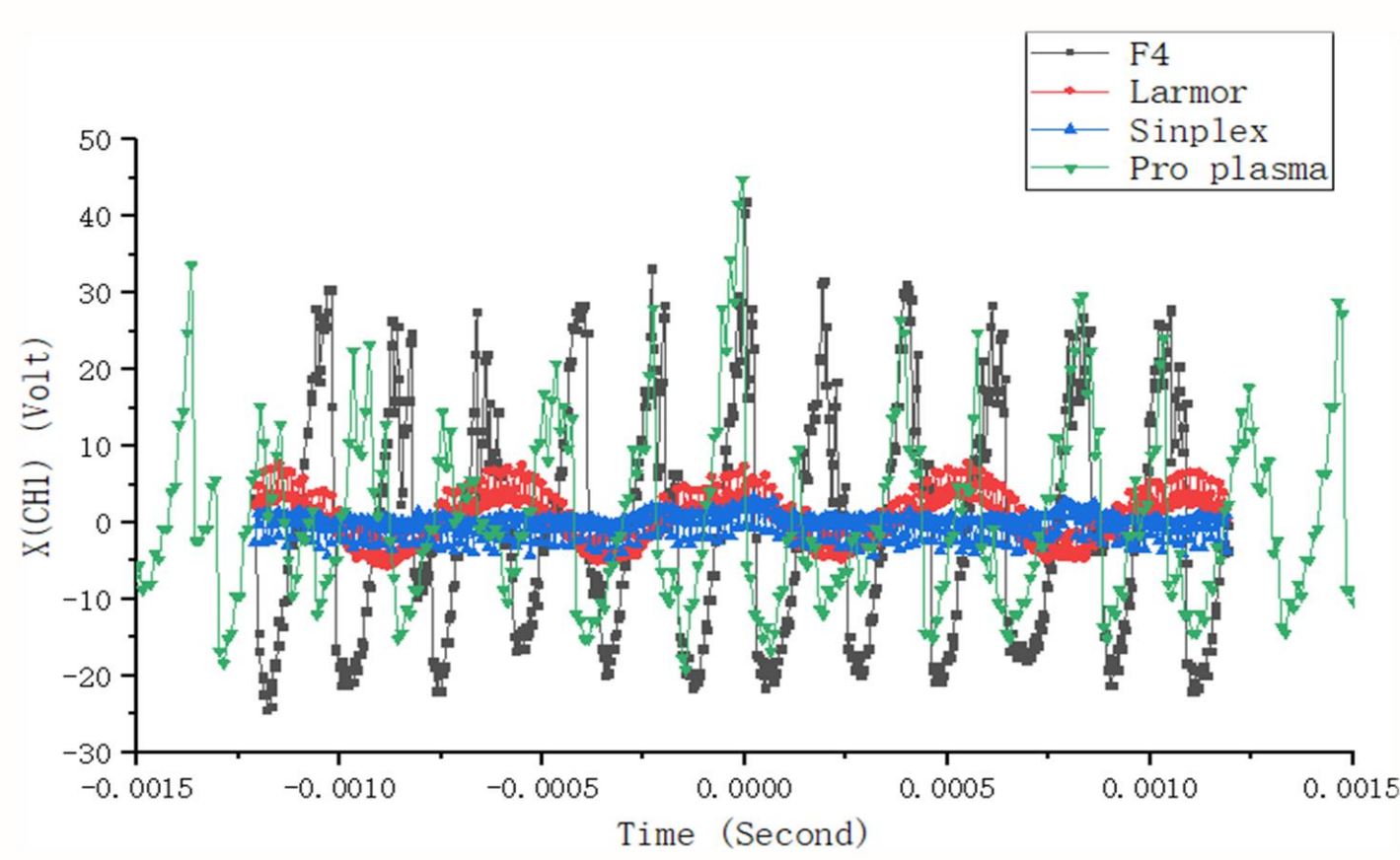


Operating parameters

Test	Plasma				Flame
Powder	IKH 10 - 38 µm				Flexicords chromia supra
Torch	F4 (Sulzer) A	SimplexPro (Oerlikon) B	Larmor 9 (Gulhfi) C	Proplasma (Saint Gobain) D	Masterjet (Saint Gobain)
Ar/H2 (L/min)	40/13	40/5	40/5	43/11	Acetylen 1bar
Current Intensity (A)	650	450	400	650	Oxygen 4 bar
Voltage (V)	65	85,4	108,9	62,1	Air 1 bar
Net power (kW)	42,9	38,8	44,0	41,0	
Power rate	55%	55%	55%	48%	
T _{input water} (°C)	14,3	15,1	14,4	16,4	
T _{output water} (°C)	30,7	27,1	32,7	31,4	
Flowrate (L/min)	16,7	20,6	15,7	20,2	
Cooling power (kW)	18,8	17,6	20,0	21,8	

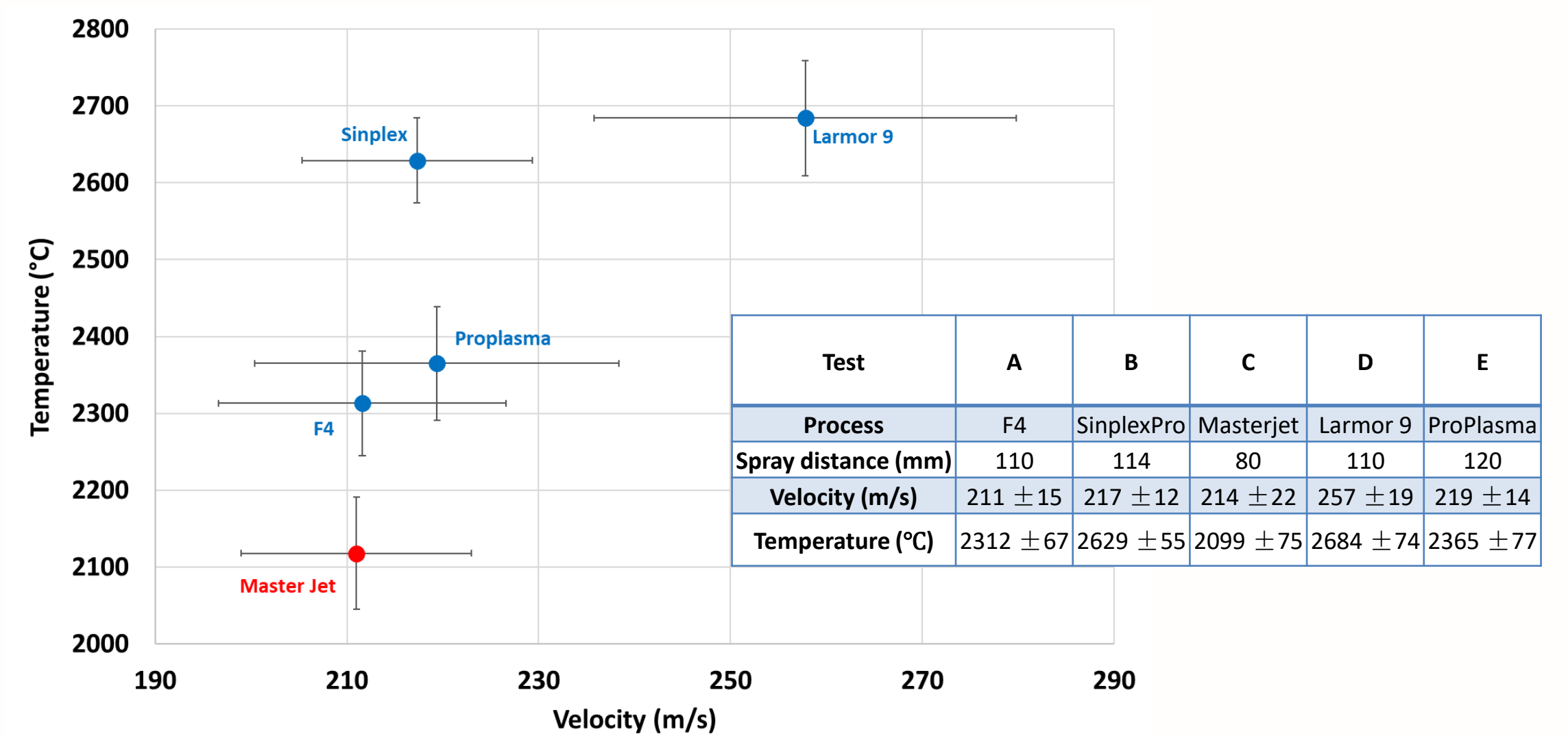


Voltage fluctuations

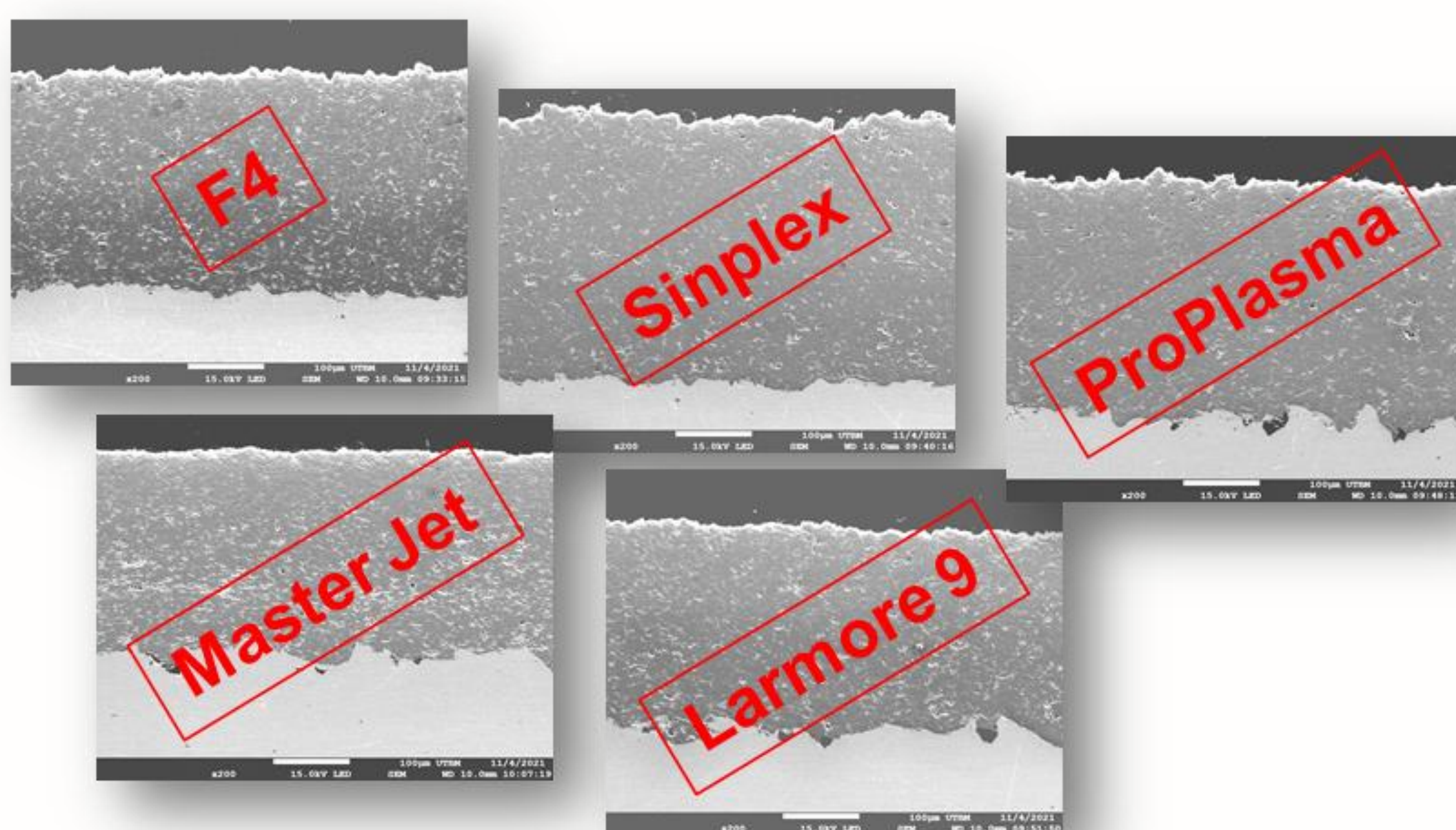


Number of stacks	Arc voltage mean value DC (V)	Arc voltage Fluctuation AC (V)	AC/DC
F4MB (A)	65	±15	23%
Simplex (B)	85	±1	1%
Larmor 9 (D)	108	±3	2%
ProPlasma (E)	62	±11	18%

In-flight particle characteristics



Microstructure of coatings



Properties of coatings

Test	A	B	C	D	E
Process	F4	SimplexPro	Masterjet	Larmor 9	ProPlasma
Porosity	1.4 ± 0.3	1.5 ± 0.6	3.0 ± 0.2	1.1 ± 0.3	1.8 ± 0.5
Hardness HV0.3	1352 ± 84	1178 ± 60	1103 ± 117	1431 ± 79	1424 ± 108
Bonding strength (MPa)	20	19	10	19	22
Deposition efficiency	40%	49%	8%	48%	29%

Conclusion

- Fluctuations:** even the geometry, nozzle diameter, stacks number, flowrate are different, a slight gap exists in between the two cascaded torch (Simplex and Larmor) given the smallest fluctuations
- Particles and coating properties:** the modification of the geometry of the torch, of the plasma gases, of the intensity of the current has a significant effect on the characteristics of the in-flight particles (velocity and temperature) and consequently on the properties of the coatings.