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Corrosion-fatigue behaviour of steel alloys under salt-spray

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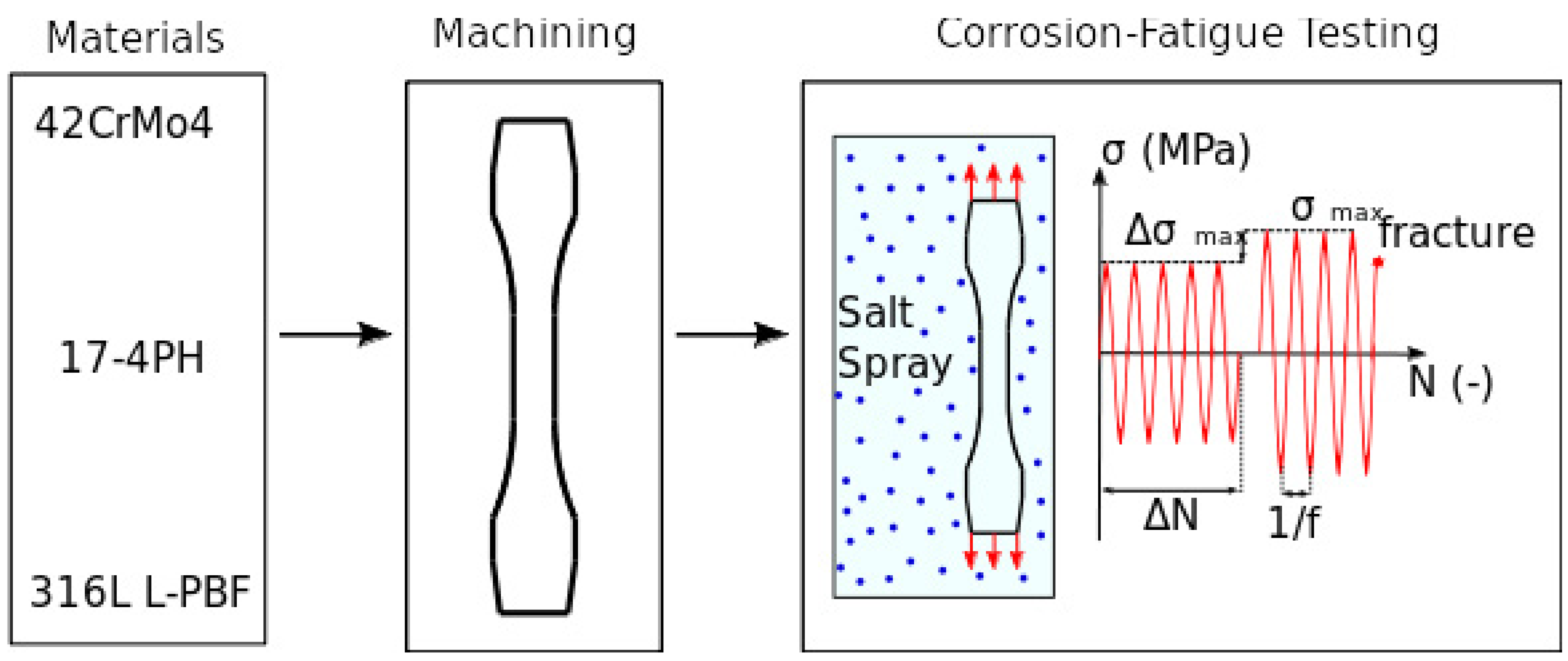
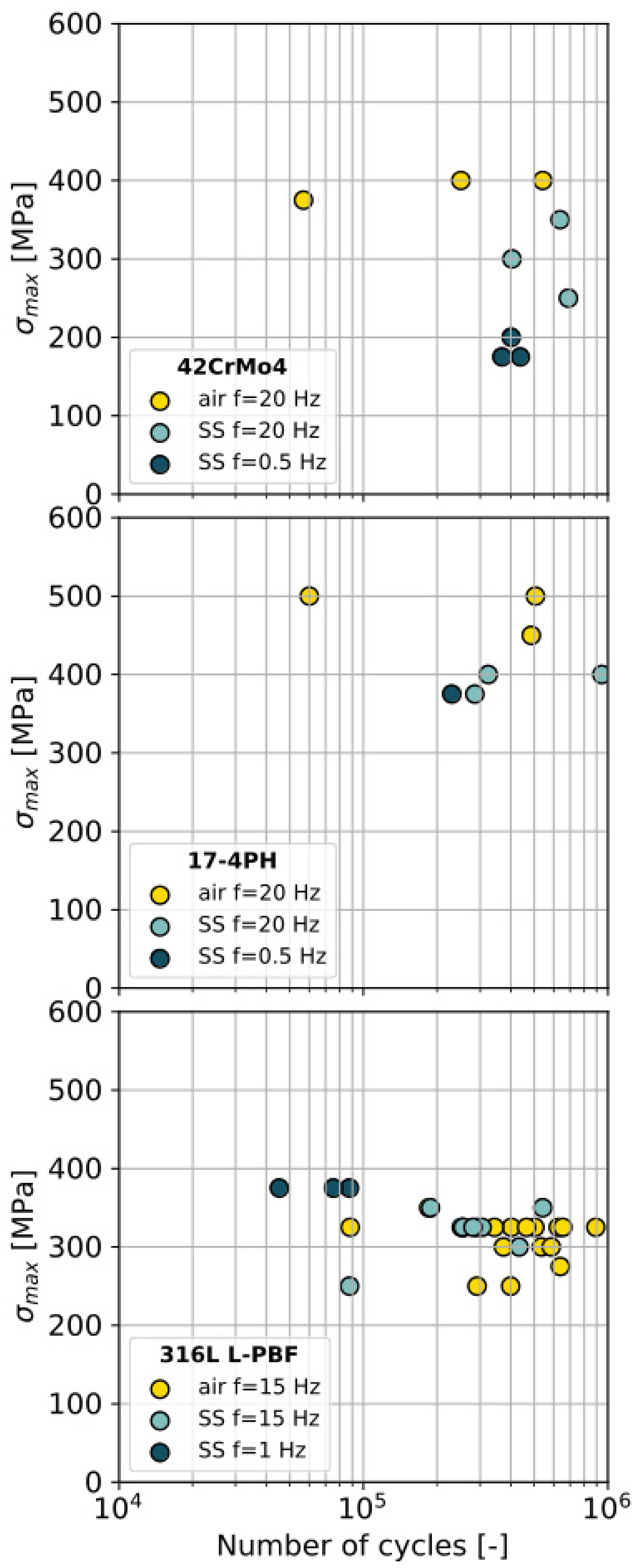
Context and objectives

Metallic materials are often used for mechanical and structural applications. Particularly, **steel** alloys present high **mechanical** properties for an affordable price. However, when subjected to mechanical **fatigue** under **corrosive** environment, **coupling** mechanisms could dramatically decrease their durability and should be taken into account to design mechanical parts [1]. This work presents an experimental method for **corrosion-fatigue** testing under **salt-spray** (SS) and results dealing with three steel alloys.

Materials and Method



- **Fatigue** batches :
  - **42CrMo4** : 3 **air** (f=20 Hz) / 3 **SS** (f=20 Hz) / 3 **SS** (f=0.5 Hz)
  - **17-4PH** : 3 **air** (f=20 Hz) / 3 **SS** (f=20 Hz) / 1 **SS** (f=0.5 Hz)
  - **316L L-PBF** : 16 **air** (f=15 Hz) / 11 **SS** (f=15 Hz) / 3 **SS** (f=1 Hz) [2]
- Step-by-step method : 10^6 cycles per step, 25 MPa between steps



Results

	42CrMo4	17-4PH	316L L-PBF
Corrosion effect	≈-50 %	≈-20 %	≈0 %
Corrosion-fatigue coupling	Weak	Strong	None

Conclusion

- **Corrosion-fatigue** test method under **salt-spray**
- Effect of the salt-spray effect on the 42CrMo4 and 17-4PH
- **42CrMo4** : **weak** coupling (time-dependent) / **17-4PH** : **strong** coupling (cycle-dependent)

References

[1] M. El May, N. Saintier, T. Palin-Luc, O. Devos and O. Brucelle, Modelling of corrosion fatigue crack initiation on martensitic stainless steel in high cycle fatigue regime, Corrosion Science 133 (2018)
[2] P. Mérot, Effet des défauts de fabrication et de corrosion sur le comportement en fatigue d'un acier 316L obtenu par fabrication additive (2021)