金属表面のXAFS測定

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謝辞

放射光利用に関して

- 高エネルギー加速器研究機構

  BL-9A,9C,11B,12C

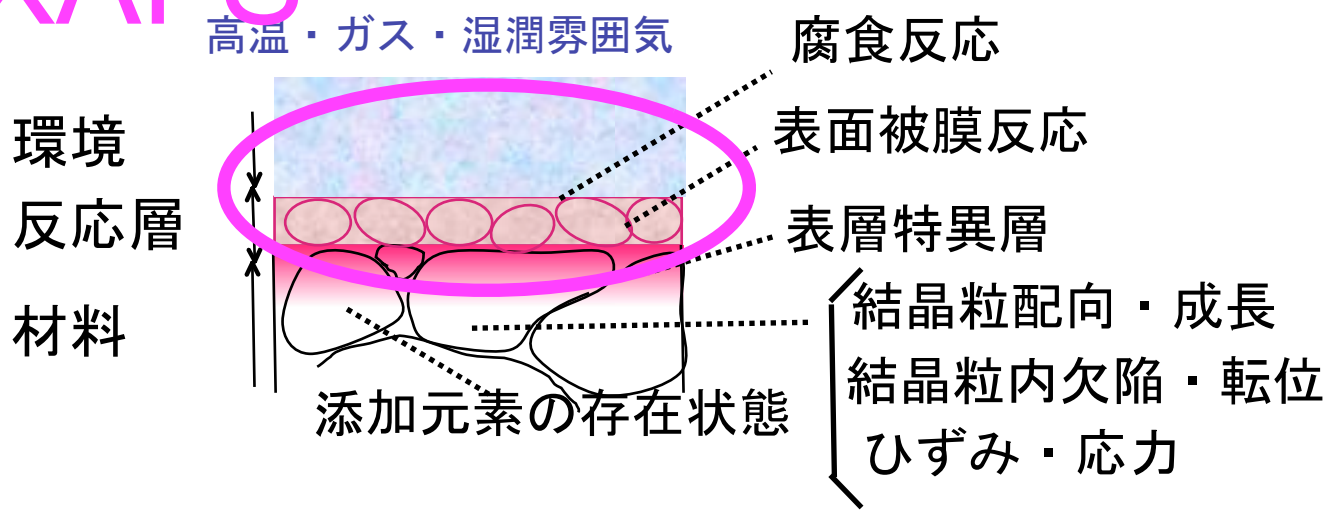
  北島義典、丹羽尉博、稲田康宏、野村昌治

実験に関して（新日鉄）

- 低合金鋼の大気腐食：紀平寛
- 放射光実験：太田典明
- 低合金鋼の大気腐食：紀平寛
- ステンレス孔食：金子道郎

金属系材料で特に重要な構造情報

蛍光XAFS



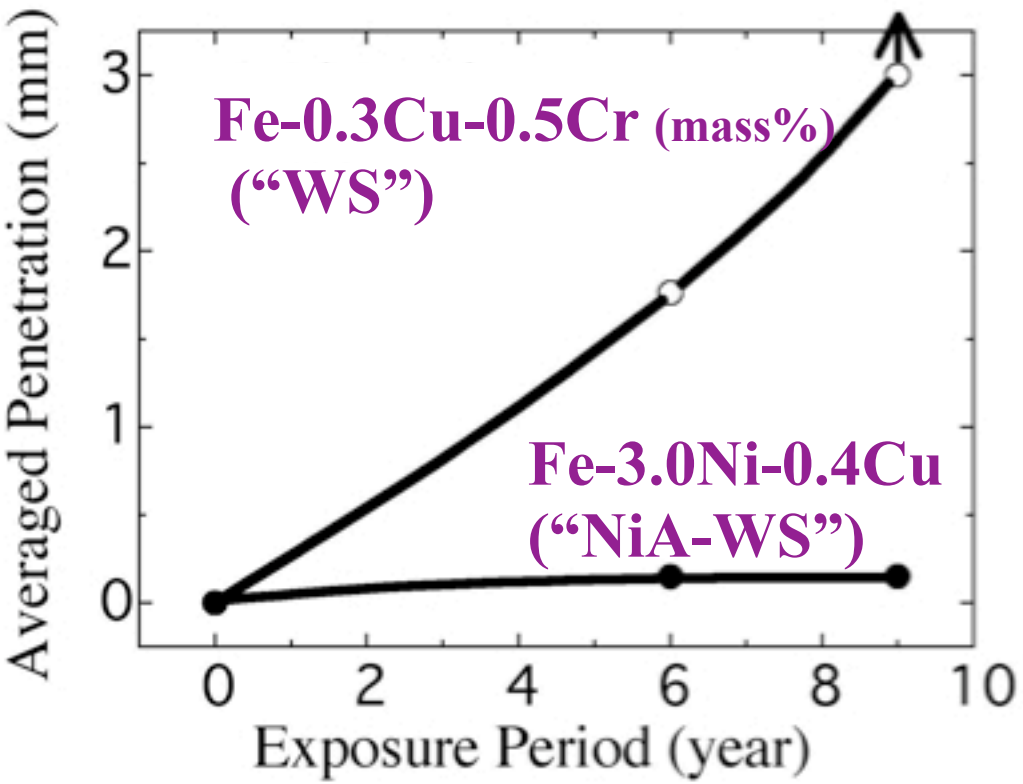
観察したい現象　×　放射光を活用した in situ 技術の開発

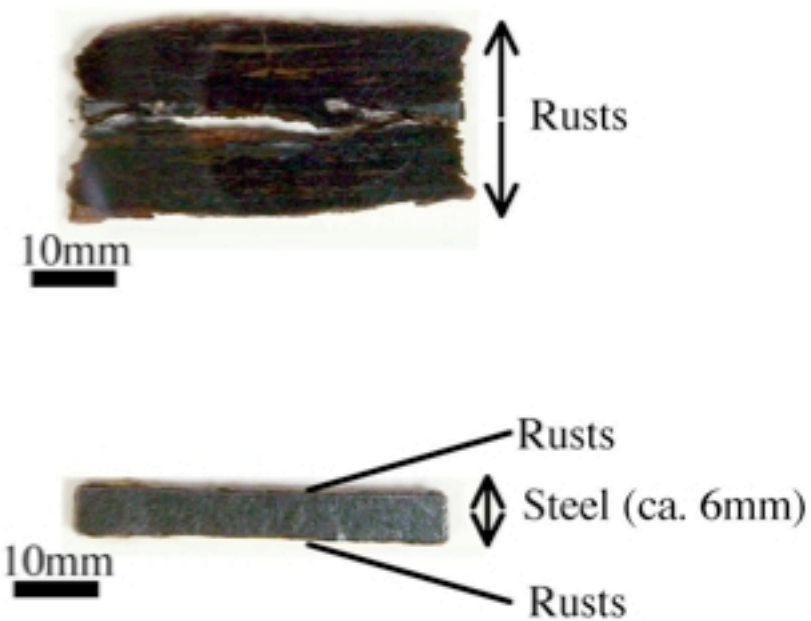
Development of advance weathering steel

H. Kihira et al., (1999,2000)

- Maintenance cost
- Environment issue

Needs for atmospheric corrosion resistance w/o coating and/or painting





Corrosion test at a coastal area

(1.3 mdd NaCl,... 10 km from the beach, Chiba, in Japan)

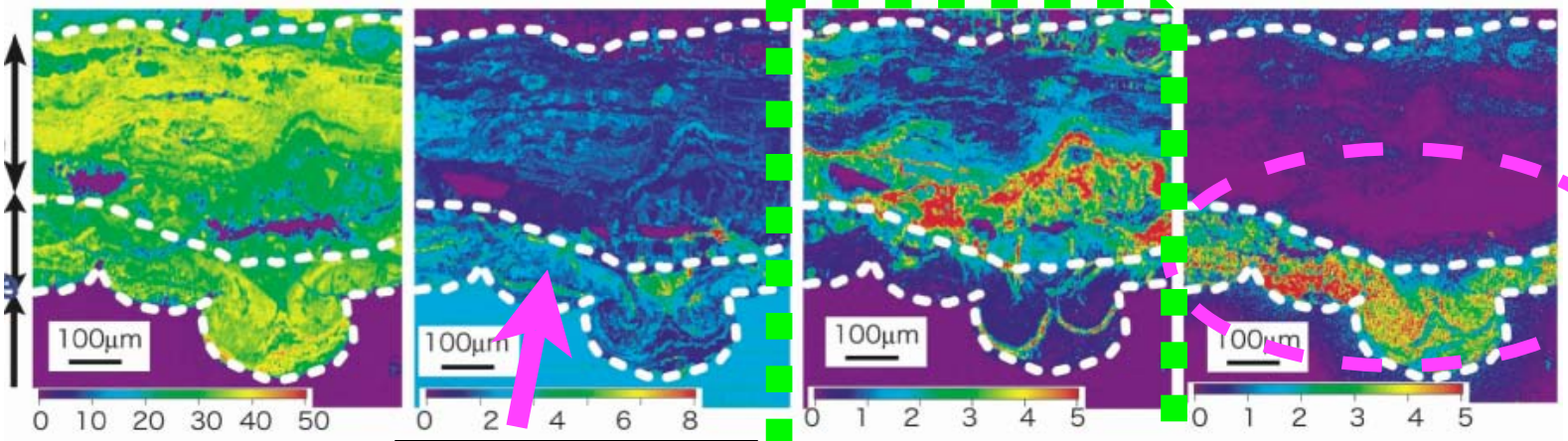
Rusts formed on weathering steel

Objective ***States of chloride in rust ?***

How does the protective rust function?

NiA-WS

Rust: Outer / Inner / Steel



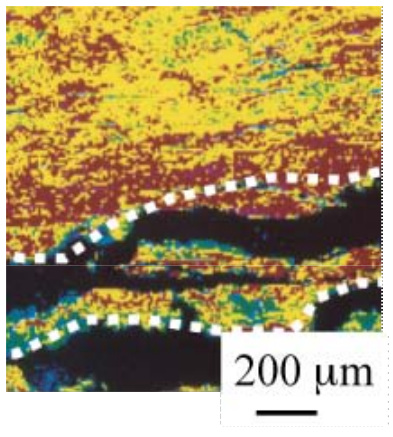
cation-selective

Fe_2NiO_4

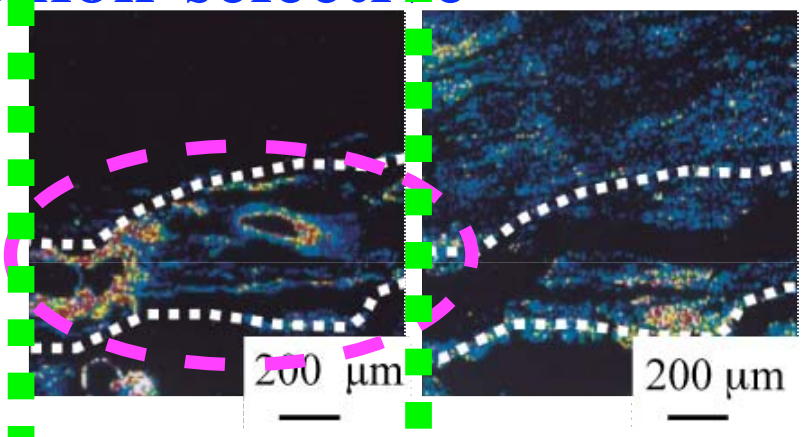
compositional mapping

WS

Rust: Outer / Inner / Steel



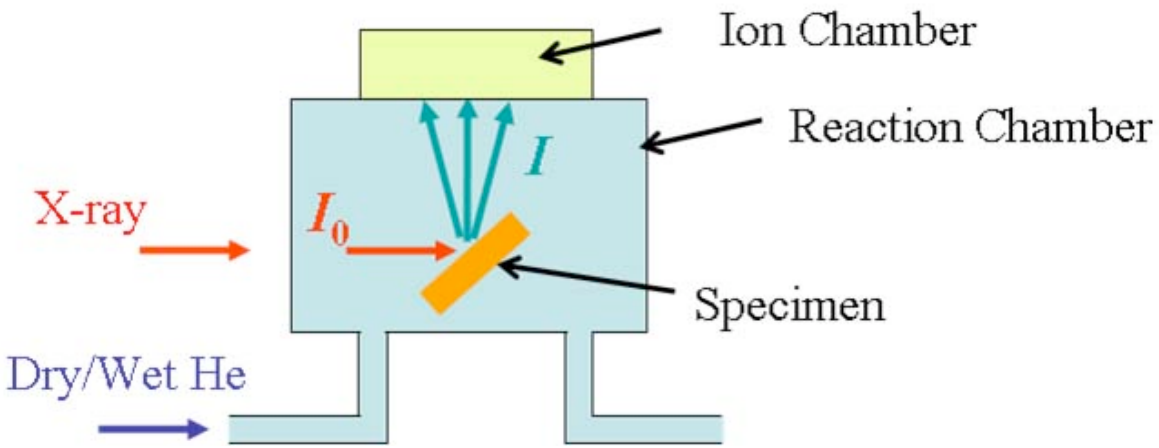
anion-selective

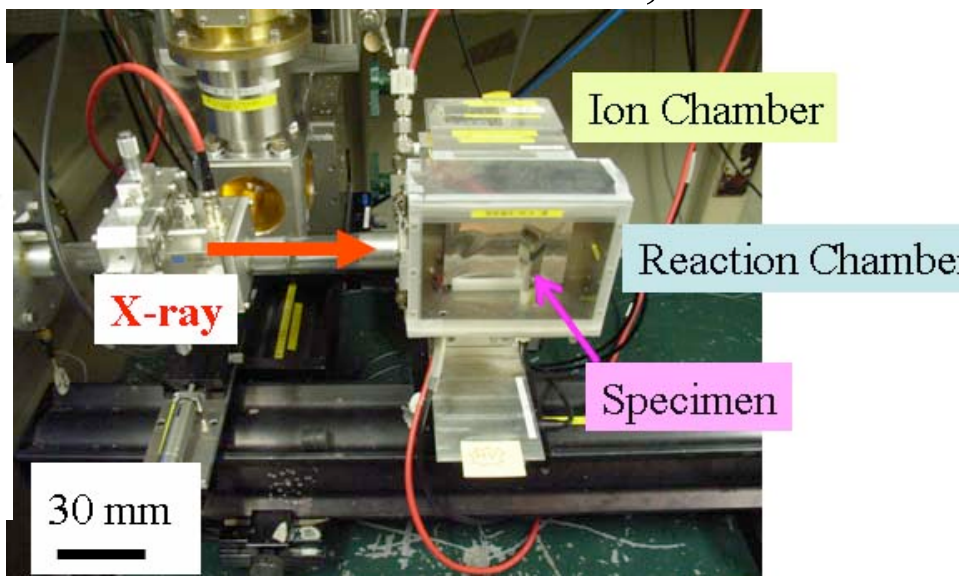


O Ni Cl Na

In situ XAFS observation during wet-dry cycles

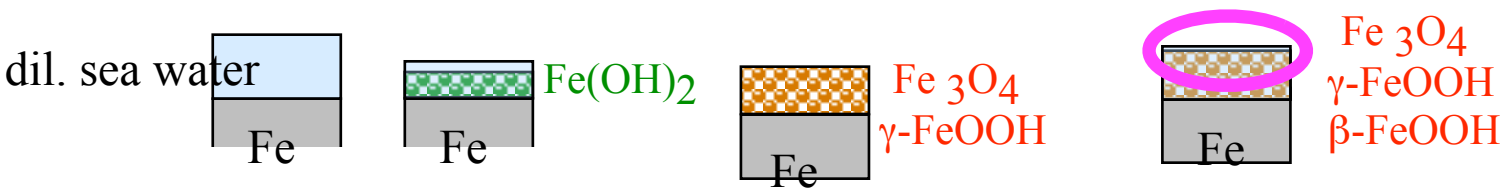
PF, BL-9A





PF, BL-9C, 11B, 12C

wet-dry cycles



sat. air → **wet cycle (90 min.)**

dry air → **dry cycle (90 min.)**

sat. air → **wet cycle (90 min.)**

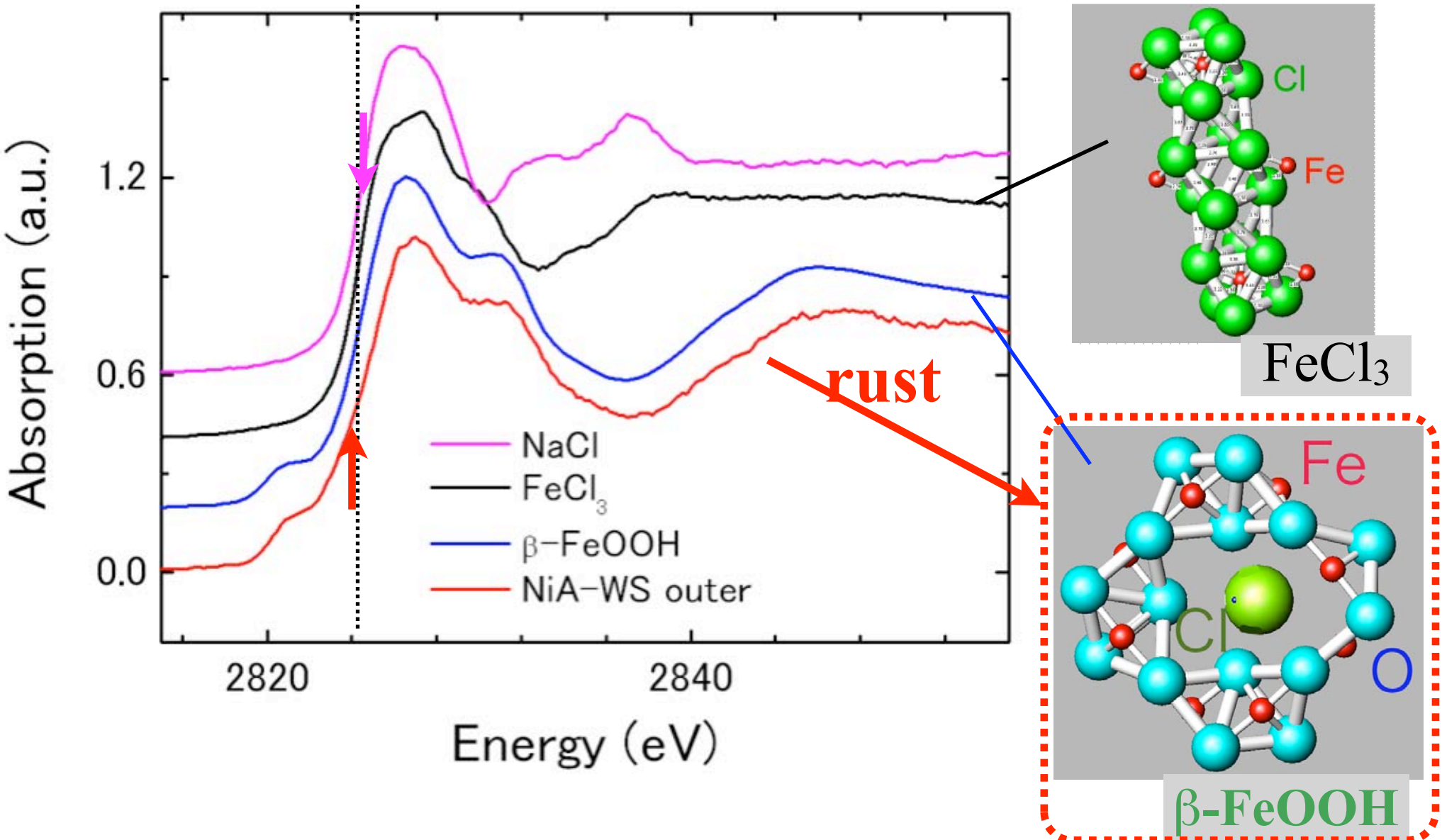
蛍光XAFS

Cl & Ni K-edge

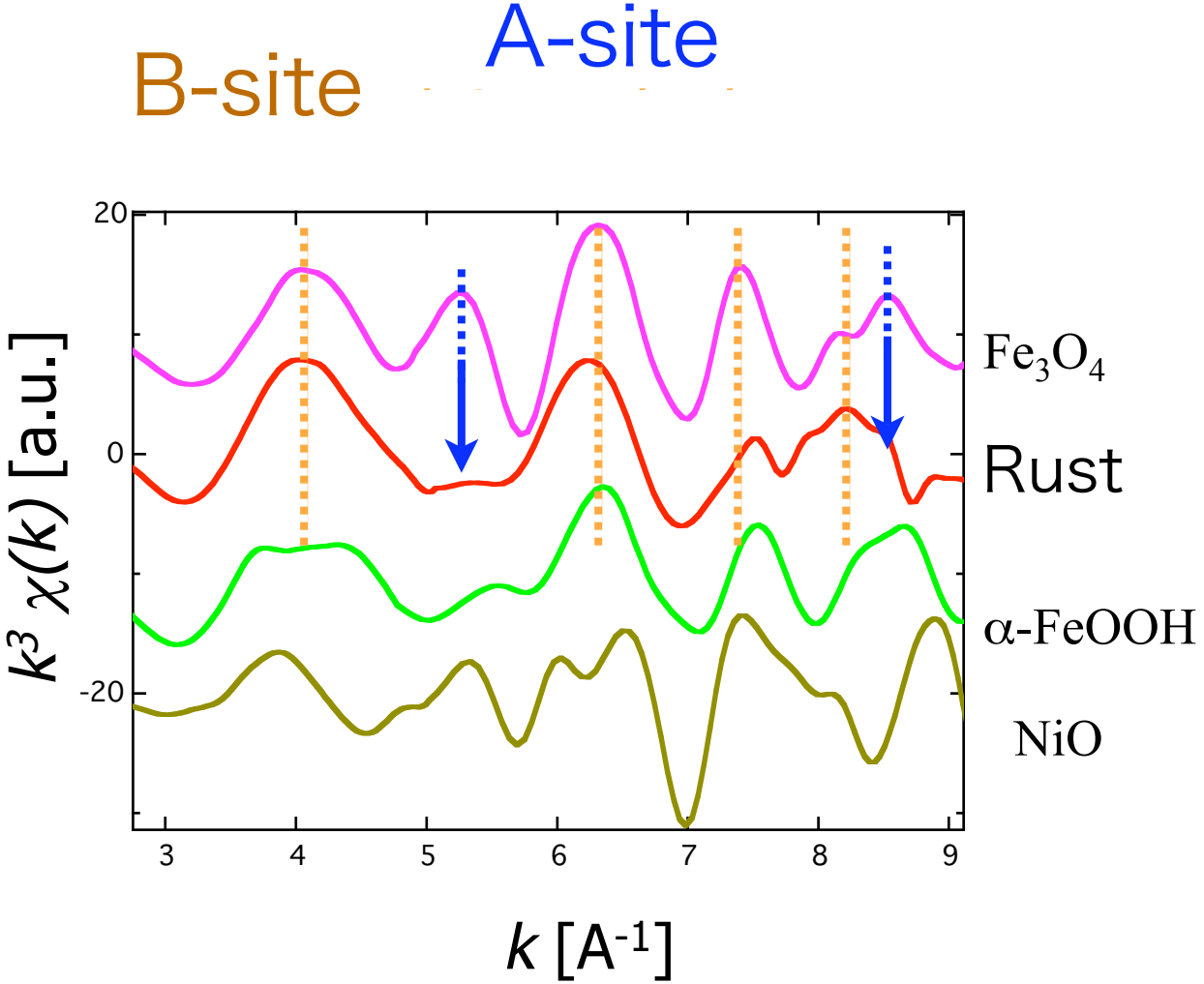
XAFS spectra of rust and references

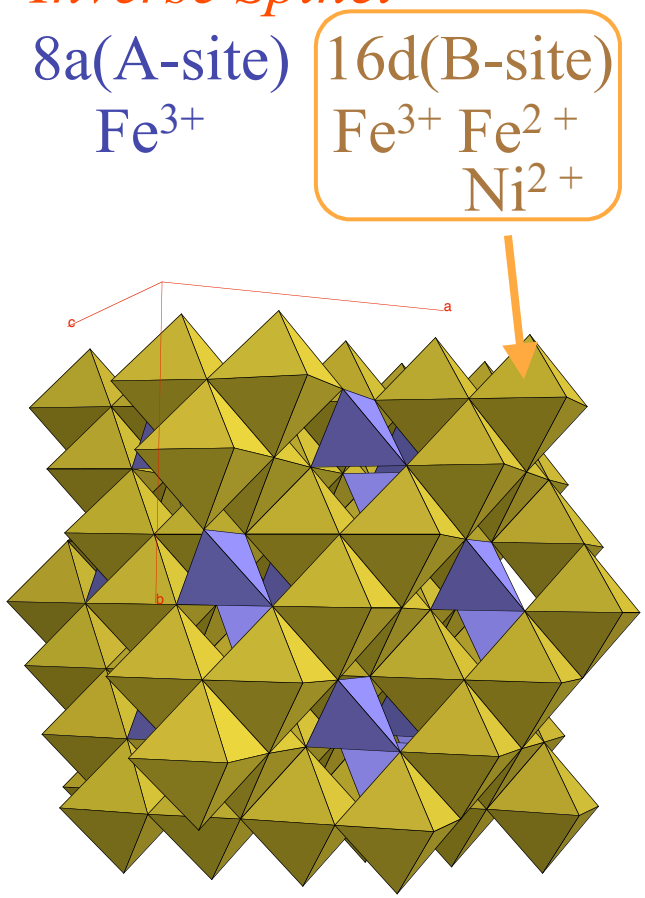
(Cl K-edge) (9 y's at a coastal area)

→ *slight but significant difference*



Ni-state in the rust by XAFS
(X-ray Absorption Fine Structure)



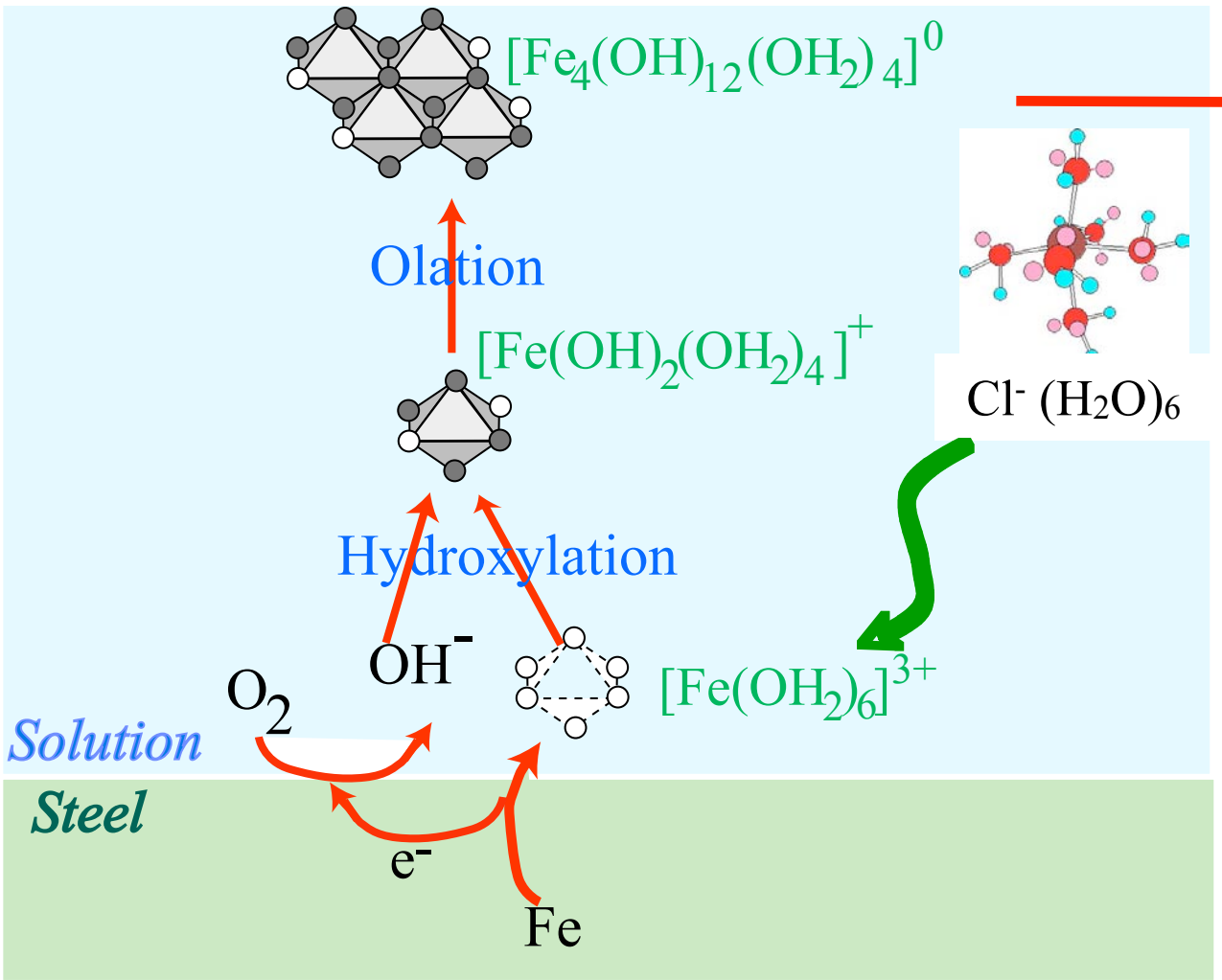


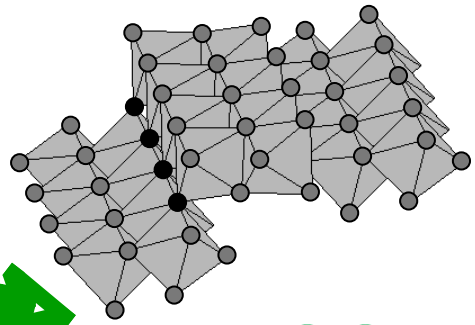
Ni substitute Fe^{2+} in Fe_3O_4

: formation of $Fe_2Ni\ O_4$

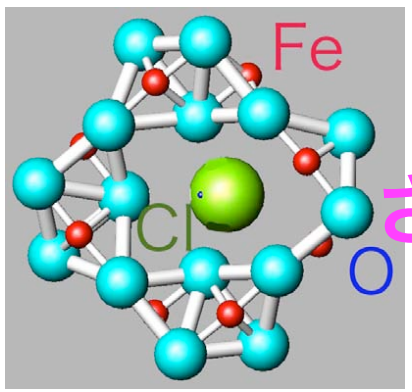
Reactions during wet-dry cycles by XAFS, 斜入射X線回折,..

Evolution of "Fe(O,OH)$_6$ nano-network"





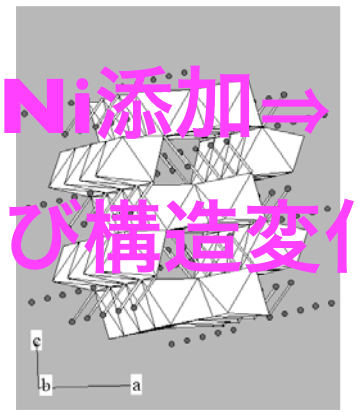
γ-FeOOH



β-FeOOH

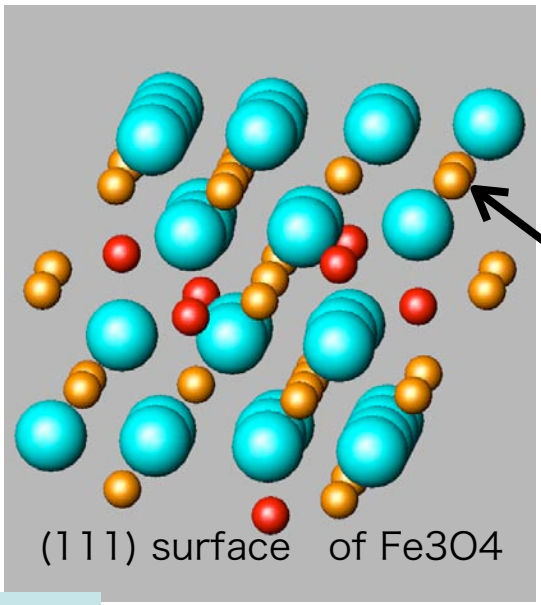
$FeO(OH)_{1-x}Cl_x$

Ni添加⇒さび構造変化



α-FeOOH

Reaction at Liq./Rust interface

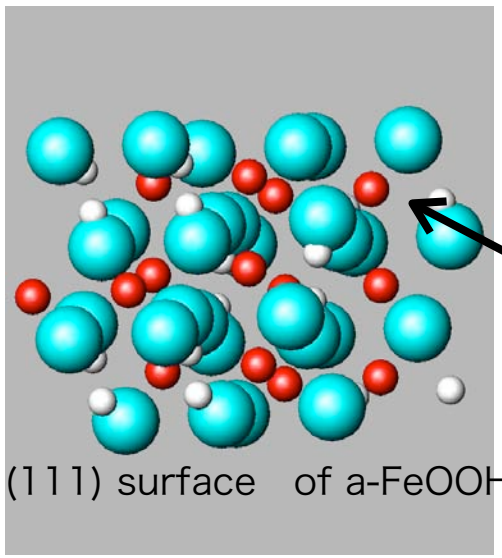


Layer of Ni^{2+} + Fe^{3+}

Fe_2NiO_4

NiA-WS

(protective rust)



Layer of Fe^{3+}

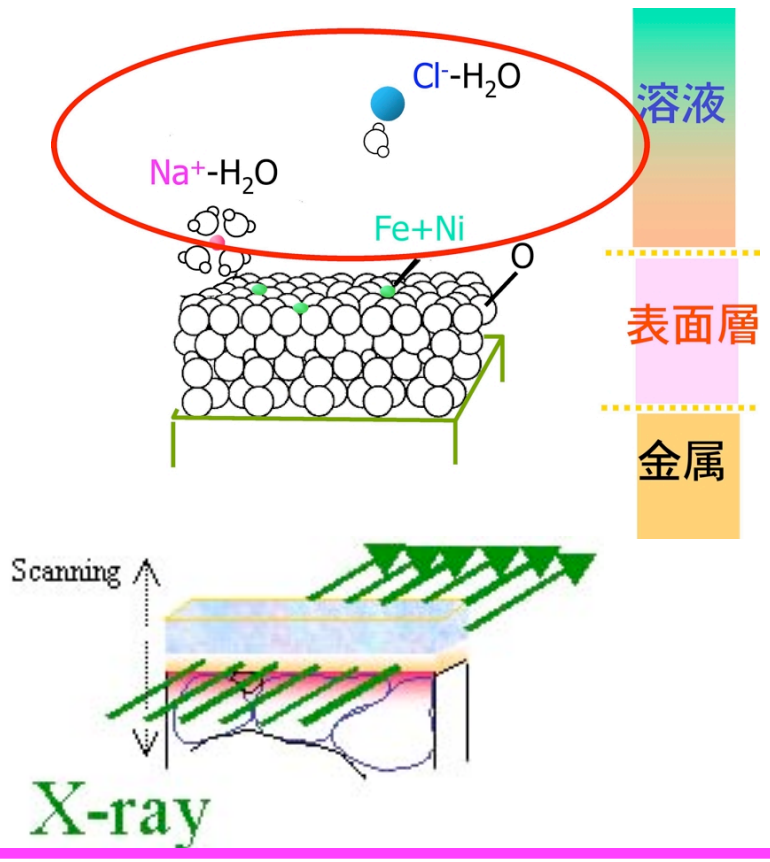
α-FeOOH

Conventional WS

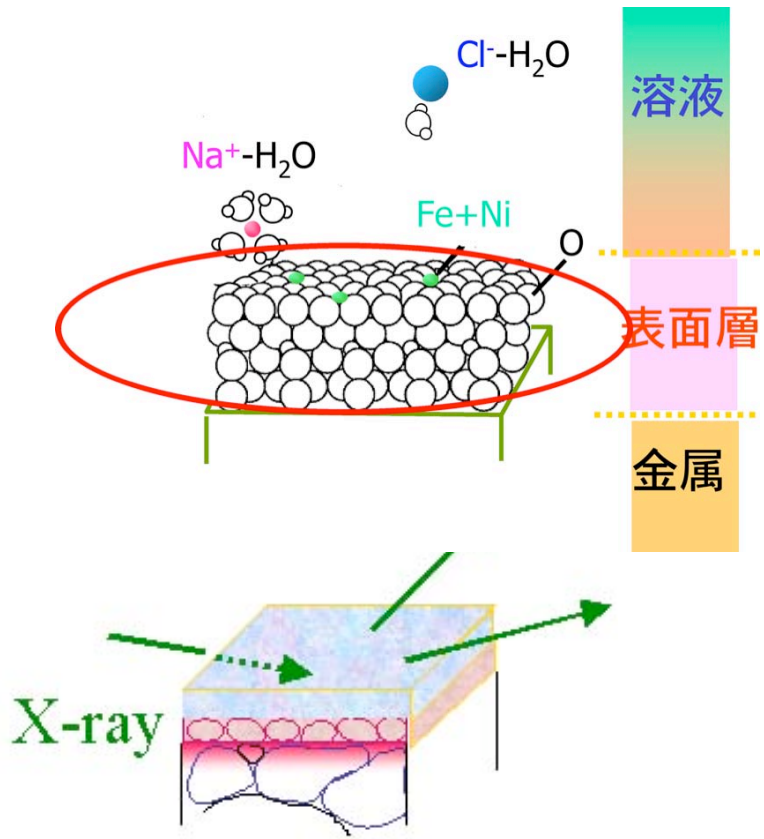
(no protective rust)

固体/液体界面の in situ 観察

A.液体中反応

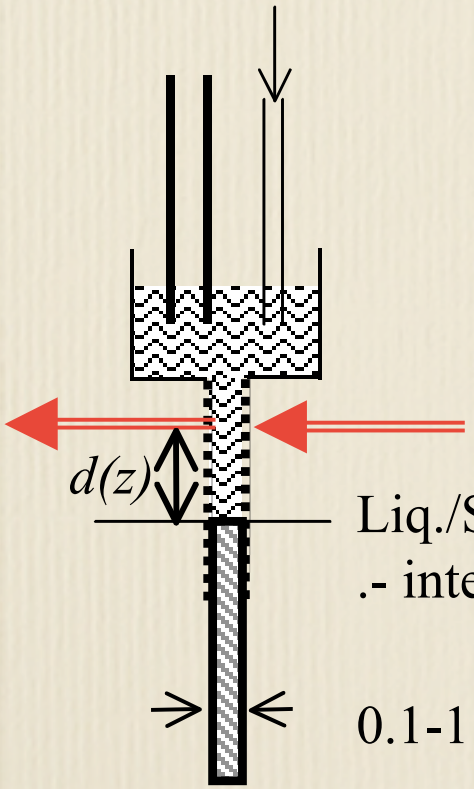


B.表層への析出反応



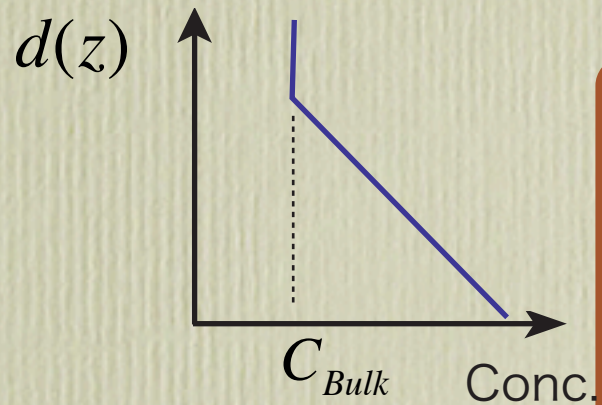
How can we observe the interface ?

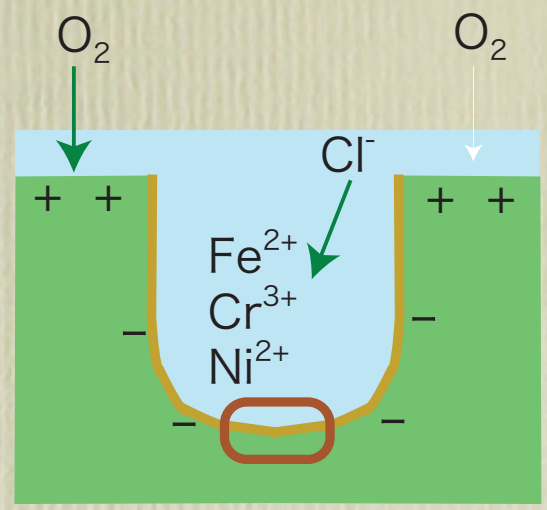
Idea for the system

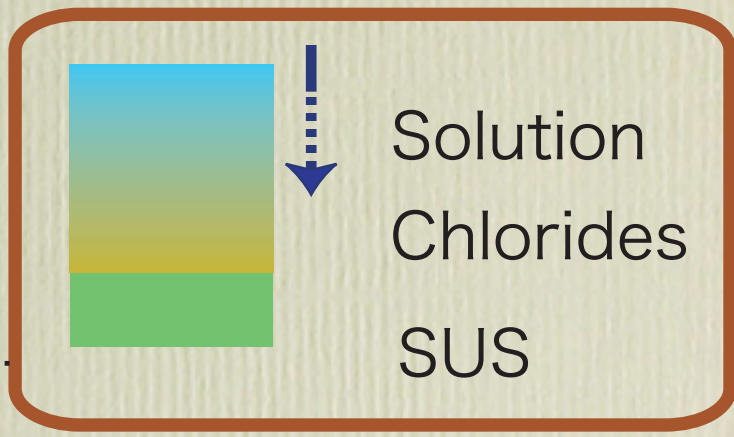


$d(z)$ range ≈ mm

Disrace from the interface



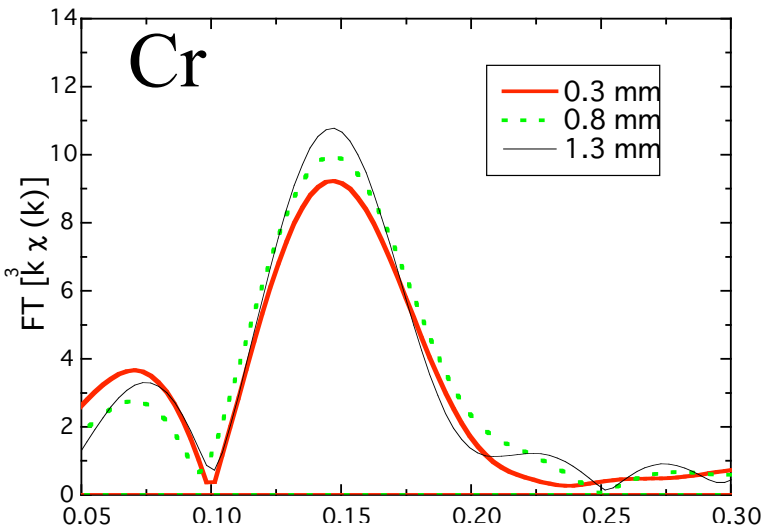


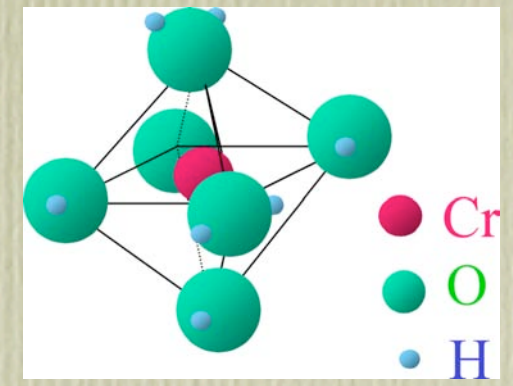


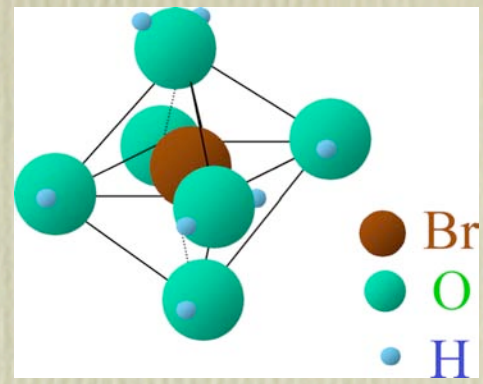
$d(z)$ range ≈ μm

Change of Structure Near Interface

Fe-18Cr-12Ni-2Mo, 1M LiBr, E=0.8V(Ag/AgCl)

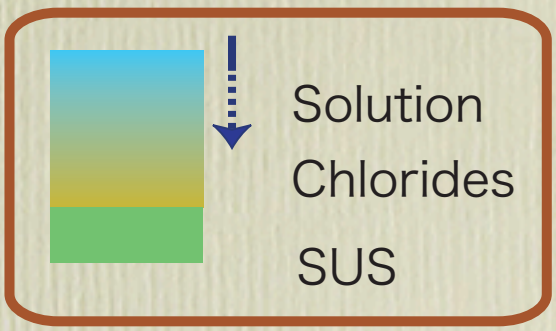


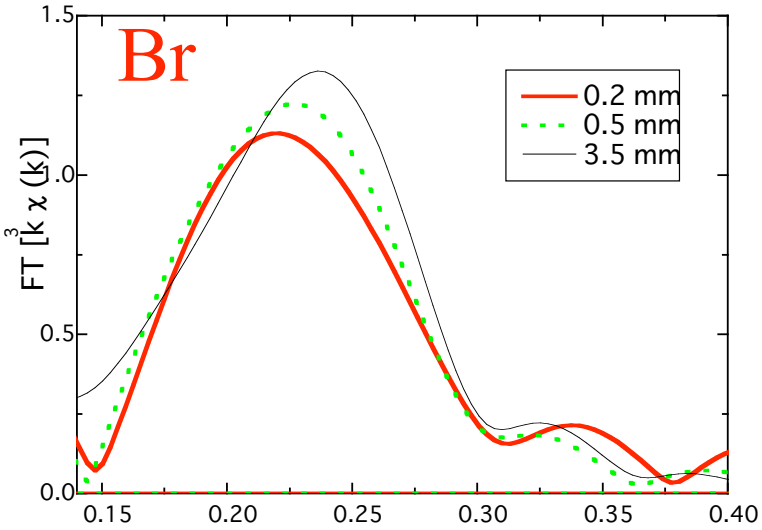


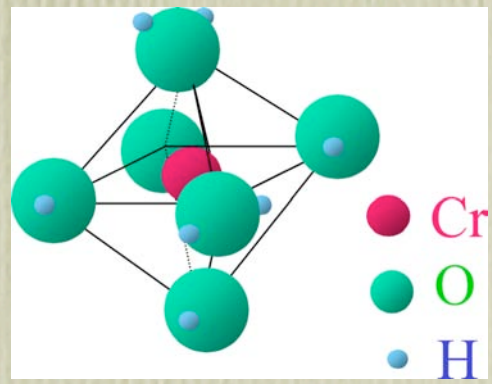


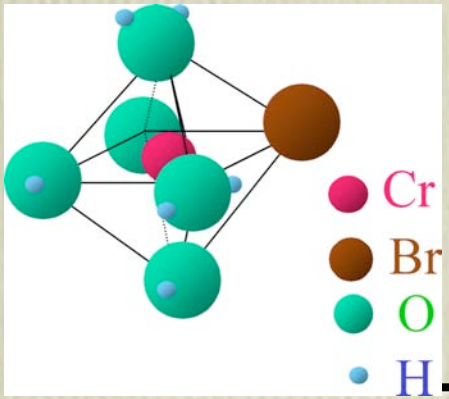
In the bulk sol.

Near interface



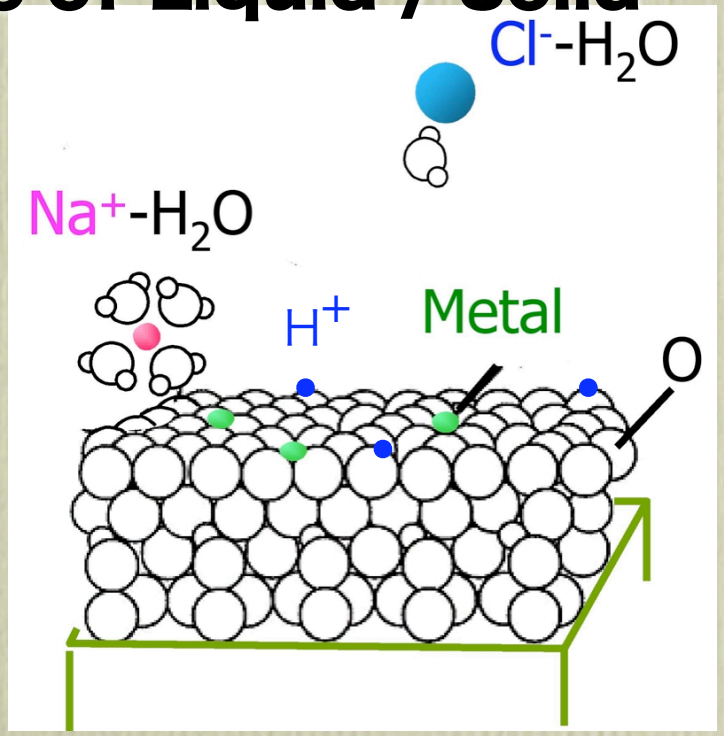






界面反応のその場観察 ←蛍光-XAFS
（耐候性鋼の大気腐食）
←透過-XAFS, 斜入射X線回折,..

Interface of Liquid / Solid



Electro-chemical reactions
(corrosion, batteries,..)
Metal-solution reactions
Catalysis

Understanding of Mechanism
&
Control of the reactions