

KFM Observation of Atmospheric Corrosion on Low Alloy Steels near Seashore Environment

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Atmospheric corrosion of steels is most commonly observed phenomena in our life. It is well known that the atmospheric corrosion of steel is accelerated by sea salt particles near seashore environment. However, the mechanism of atmospheric corrosion of steel has not been clarified because of the difficulty in experimental work. We have developed a new atmospheric corrosion test device that can control the amount of attached sea salt particles. By using this device, certain amount of sea salt particles were attached on the low alloy steel and the initiation of atmospheric corrosion was observed by both the super Kelvin force microscope (SKFM)[1],[2] and Kelvin force microscope (KFM).

Test specimens used were 2 types of low alloy steels, 3%Ni and 3% Cr steel, mechanically polished up to 1 μ m roughness. Sea salt particles were attached by using the new atmospheric corrosion test device under low humidity conditions (30%RH) for preventing the corrosion. The amount of attached sea salt particles was estimated by using 30MHz of gold-coated quartz crystals. The nucleation of thin liquid film was observed by KFM and SKFM at RH of 35% to 40% after keeping the specimen at 85% RH for 1 h with attaching sea salt particles of 0.02 mg/cm². The initiation of atmospheric corrosion was observed by KFM under constant humidity (40%RH) conditions. The KFM image was taken every 45 minutes for 1 week and the optical microscope observation was also done after test.

The KFM images of 3%Cr and 3%Ni steel after keeping at 85%RH for 1h shows the generation of thin liquid layer was observed near the corroding parts. Fig. 1 shows the KFM observation of 3%Ni steel at 40%RH condition. Corrosion started from sea salt particles (Fig. 1 (b)) and propagated in most case as the filiform-type of corrosion. Once the front on corroding part reached at the sea salt particles, the potential of the sea salt particle moved rapidly to negative direction and corrosion started in the sea salt particles to change the shape of the sea salt particle (Fig. 1(c)). Fig. 2 shows the KFM observation of 3%Cr steel at 40%RH condition. As well as in the case of 3% Ni steel, corrosion started from the sea salt particles and the potential of the sea salt particle moved rapidly to negative direction. However corrosion propagated in most case as the disk-type of corrosion and total amount of corrosion was bigger than that of 3%Ni steel. The difference of corrosion morphology seemed to be related the stability of iron chloride produced by corrosion. Additive element of Cr decreases pH at corroding part, which is considered to increase the stability of iron chloride.

REFERENCES

- [1] H.Masuda, *Corrosion*, **57** (2001) 99
[2] H.Masuda and K.Noda, *J. Electrochemical Society*, Proc. Vol (The 196th Meeting of ECS), **99-28**, (2000)351

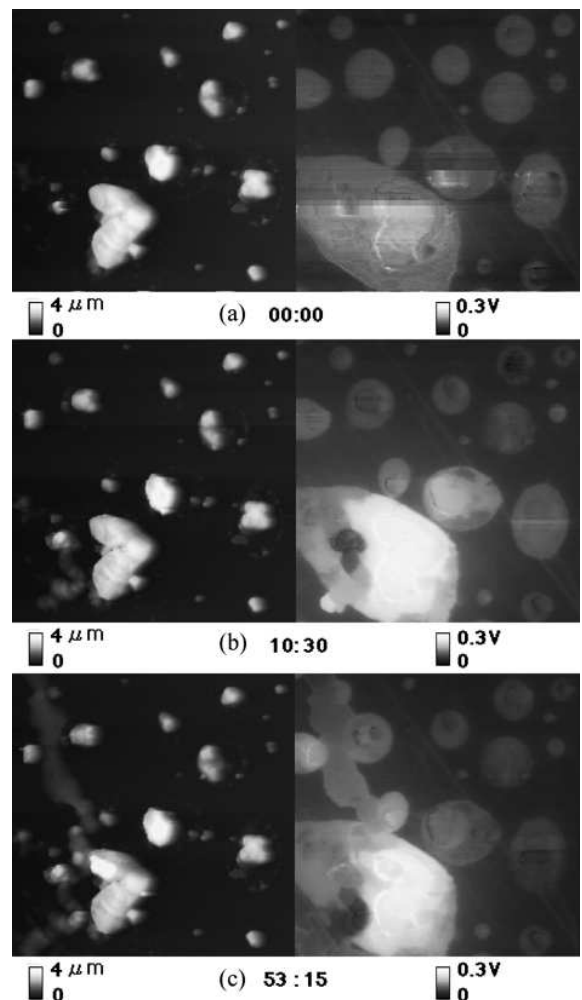


Fig.1 KFM observation of atmospheric corrosion of 3%Ni steel at RH of 40%. (0.08mm X 0.08mm)

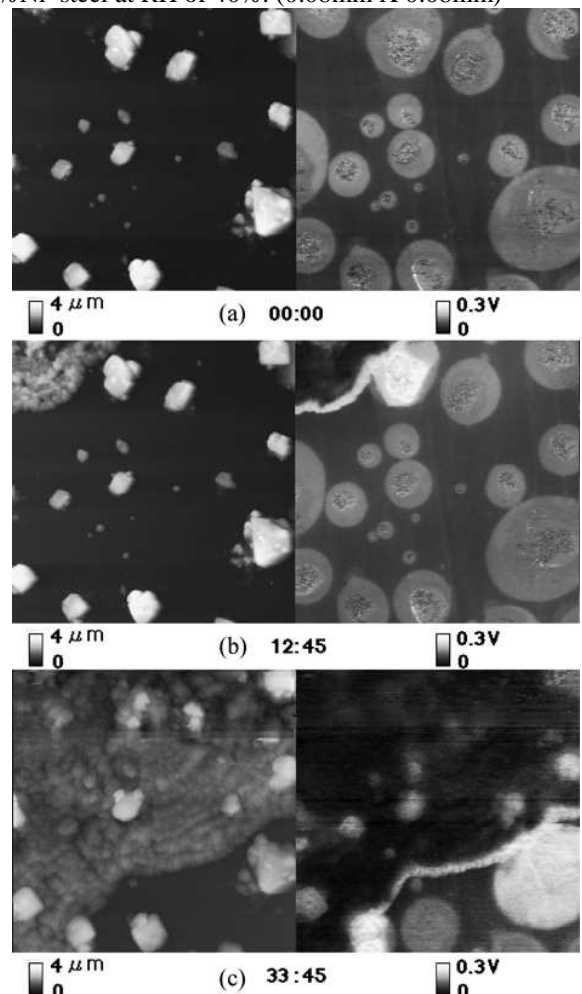


Fig.2 KFM observation of atmospheric corrosion of 3%Cr steel at RH of 40%. (0.08mm X 0.08mm)