

X-Ray Reflectivity study on surface treatment materials obtained by cluster ion beam techniques

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We have tried production of an X-ray mirror by "Gas cluster ion beam (GCIB)" processing method. This time, X-ray reflection of the sample produced by GCIB method was measured.

The energy of the incident X-rays was 10keV and 6keV. Ion chamber was used for the measuring instrument at the time of 10keV X-ray, and Scintillation counter was used for it at the time of 6keV. This is because it was difficult to cover the dynamic range of 4 figures at the time of 6keV in Ion chamber. Since substrate was small, the incident slit was adjusted so that X-rays might be set in substrate with a 2theta > 0.2 degree.

Fig1 shows the reflectivity when 10keV energy X-ray was used in the case of ① irradiating sample by GCIB ② not irradiating sample by GCIB and ③ simulation results⁽¹⁾ based on Si material (the roughness Ra is assumed to be 0 nm). The results show a good agreement between the measurement and calculation results. The reflectivity tended to decrease when the GCIB acceleration voltage (Va) increased. For the GCIB method, if Va is high, it has already turned out that a surface treatment becomes effective. Therefore, it suggested that the optimum acceleration voltage exists in which a high-speed and highly precise surface treatment can be obtained.

Fig2 shows the reflection characteristics at the time of irradiating X-ray(10keV) on a SiC board (polishing article) with a golden coating of 85nm thickness on the surface. Calculation value was also written together. The results

show that reflectivity is improved drastically by golden coating. For the sample without golden coating, when X ray energy was 10keV, reflectivity falls drastically at 0.18 degrees (incidence angle) or more. In 6keV, reflectivity falls drastically at 0.28 degrees or more.

References

- (1) CXRO's Home Page
"http://www-cxro.lbl.gov/"

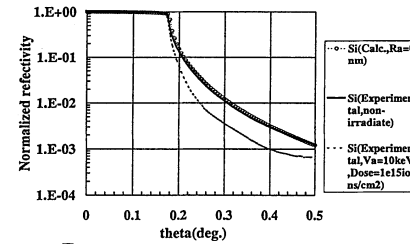


Fig1.

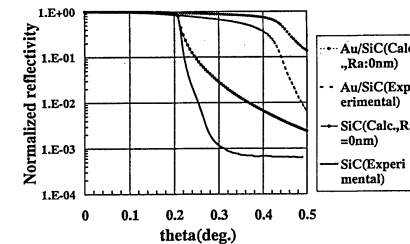


Fig2.

Analysis of Crystal Structure for Porymercement

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A material of polymer cement group forms a membrane as having hydration reaction with moisture within emulsion by mixing polymer emulsion and cement. Those polymer cement are widely used among industry, especially construction and civil engineering fields mainly use EVA resin and/or acrylic resin as polymer with portland cement and/or alumina cement.

By hydration reaction of cement, portland cement produces CaO-SiO₂-H₂O from its main component C₃S and C₂S, on the other hand, alumina cement produces C₃AH₆, CAH₁₀ and C₂AH₈ from its main component CA, each material shows different reaction speed and different crystal structure after hydration reaction as a matter of course the original structure of crystal. Also, having different results of its reaction speed and reaction products from type of polymer to be used could be expected from its properties, analyzing over crystal structure of cement produced from hydration reaction among polymer cement would anticipate further industrial development.

(Notes) C: CaO S: SiO₂ H: H₂O A: Al₂O₃

Prepare 3 kinds of solution; water, EVA resin emulsion and acrylic resin emulsion, and 2 kinds of cement; portland cement and alumina cement, mix each material for samples. Curing conditions after membrane formation are following 3 types; normal condition, 48hrs and 168hrs curing in water. Have an X-ray (1 Å wavelength) examination on each sample and detected returned X-rays with a two dimensional detector.

Referring Fig. 1, water and alumina cement mixture shows a small amount of non-reacted CA and crystals being produced by hydration reaction C₃AH₆, CAH₁₀, and C₂AH₈(○), which can be recognized that the hydration reaction is under sufficient process.

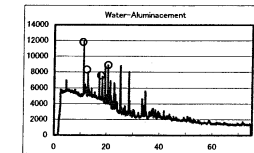


Fig. 1

From Fig. 2 and 3, both obviously show the peek of non-reacted crystal CA around 20° point (Δ). However, even a small amount the crystals as C₃AH₆, CAH₁₀, C₂AH₈ are seen after hydration reaction, somewhat hydration reaction is considerable. Little difference between EVA resin and acrylic resin is recognized and shows no remarkable distinction among resins. However, it would appear that having faster reaction speed and easier having hydration reaction with EVA resin than acrylic resin, it requires more research on this subject to determine the stated matters et al.

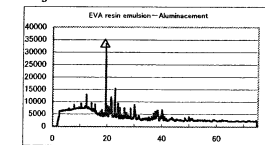


Fig. 2

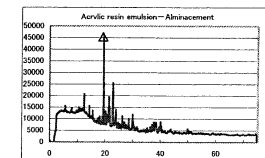


Fig. 3