Depth profiles of residual stress in ceramic film and substrate

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In the previous experiments such as 2002A0329-ND1-nd and 2002A0650-NI-nd, the non-linear property of the sin²ψ plot had been employed to obtain the depth profile of the residual stress. It became clear, however, that it is difficult to determine the accurate depth profile using the non-linearity of the sin²ψ plot because of the preferred orientation of the sample.

In this experiment, a different scheme was tried to assess the depth distribution of the stress. The penetration depth of the X-ray into the sample was kept constant by controlling θ and χ angles throughout the measurement of one series in the sin²ψ plot.

Figure 1 shows a typical sin²ψ plot of the constant penetration depth measurement. The penetration depth was kept to be 5.9, 2.4 and 1.2 μm in each series respectively. The sample was a 12 μm TiCN film deposited on a cemented carbide substrate, which is thought to have a stress distribution in depth direction. The difference in the slope of the three lines indicates the change of the stress in depth direction.

Analysis of Crystal Structure for Polymericement

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In the civil engineering and construction sector, most of the polymericement membrane waterproofing materials now on the market are P/C (polymer/cement) = over 100% compounds. Polymericement membrane waterproofing material is used by mixing polymer emulsion and cement (generally quartz sand are combined) together at the building site, applying 1 to 2 mm thick then the dried harden film becomes waterproofing membrane. Polymericement forms the membrane by evaporation of moisture within polymer emulsion to the air and hydration reaction of cement with moisture in polymer emulsion.

Under the various circumstances actually used, it is necessary to have proper responded waterproofing membrane formation, that is, analyzing the process of hydration of cement in polymericement assuming the practical matters may be expected further development in the waterproofing sector and also have potentials to contribute wide range of adoption to the material of other industrial sectors.

According to the results of previous heat of hydration determinations, the speed of hydration using ethylene-vinyl acetate resin (hereinafter called EVA) is faster than that of acrylic resin (hereinafter called AC), and also alumina cement shows faster hydration speed than that of Portland cement, a testing piece was selected so as EVA for polymer and alumina cement for cement.

For preparation of a testing piece, EVA emulsion and alumina cement were mixed, then immediately applied onto 10×10×0.15 mm glass plate making the coat 1 mm thickness, and covered with another glass plate. X-ray (1A wavelength) was irradiated to the sample with time lapse and detected diffracted returned X-rays from the sample by a two-dimensional detector.

Fig. 1 shows the results obtained. The point remarkably shows the peak of crystal of unreacted hydrate in an hydrated cement is around 20°C so that extracted changes of time lapse from the mixing point up to 360 minutes, also extracted remarkable points of peak of crystal after hydration as well. From the results of this test, at the start of the mixing shows condition of a small amount of hydrate, and yet increase of hydrate could be recognized over time lapse. As this testing was qualitative analysis, however, determinations were done with time applying one testing piece being settled, it may be possible to compare the strength of peaks and is apparent that the hydration is proceeding among the thin polymericement coating.