J12 Passport Examination by a Confocal Type Laser Profile Microscope

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The goal of this presentation is to measure the film thickness on the paper using a confocal type laser profile microscope, which is nondestructive and precise. The authors will demonstrate usefulness of the confocal type laser profile microscope for passport examination.

The film thickness on the paper using a confocal type laser profile microscope is measured, which is nondestructive and precise. The usefulness of the confocal type laser profile microscope for passport examination is demonstrated.

Three genuine Japanese passports and 26 counterfeit Japanese passports were used. Genuine passports were numbered from 1 to 3. Counterfeit passports were numbered from 4 to 29. The materials of the films on the samples were examined by the ATR-FTIR method. Polyethylene terephthalate (PET) film was used for all genuine passports and 9 counterfeit passports. Polypropylene film was used for 6 counterfeit passports. Polyvinyl chloride (PVC) film was used for 11 counterfeit passports.

The film thickness was derived from the surface profile of the film and the interface profile between the film and the paper measured by the confocal type laser profile microscope (Keyence Co.VF-7500). The surface and interface profiles were measured at four different places for one sample and measured twice at each place.

The thickness was derived by the algorithm that was made with the technical computing language “Matlab.” The linear lines were fitted to the profiles by least square methods. The outliers in the profiles were removed iteratively in the program. The distance between the fitted lines to the surface profile and the fitted lines to the interface profiles was regarded as the thickness of the film.

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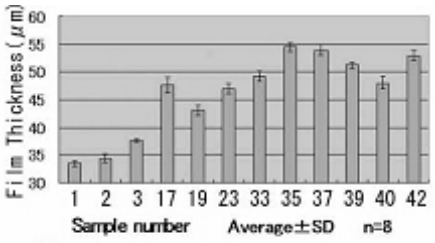

Fig. 1 Thickness of PET films

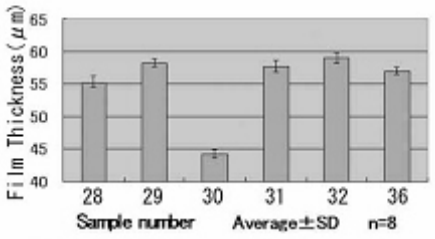

Fig. 2 Thickness of polypropylene films

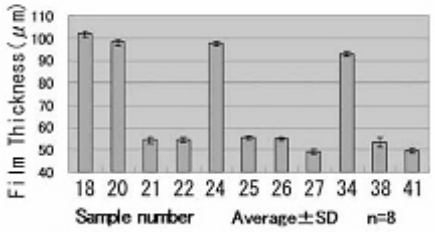

Fig. 3 Thickness of PVC films

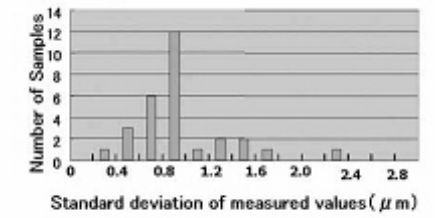

Fig. 4 The accuracy of thickness measurements
Average :0.96μm Maximum:2.28μm

Fig.1 shows thickness of PET films that were used on both genuine and counterfeit passports derived by this method. Error bar shows the standard deviation of eight measurements. Genuine passports and counterfeit passports definitely differ in their films' thickness. It is supposed that this is because thin films are more difficult to be laminated without wrinkles than thick films. The genuine passports and the counterfeit passports that cannot be distinguished by the ATR-FTIR method are briefly discussed. Fig.2 and Fig.3 show thickness of polypropylene films and PVC films that were used on the counterfeit passports. Researchers can find the differences among the counterfeit passports that cannot be found by the ATR-FTIR method. Fig.4 shows a histogram of the standard deviation of eight measurements giving the accuracy of thickness measurements. Most samples could be measured with the standard deviation less than 1?m. The average of the standard deviation was 0.96μm. The maximum value of the standard deviation was 2.28μm.

Tthe film thickness was undesrtuctively measured without peeling the film from the paper by the confocal type laser profile microscope. The thickness of films on Japanese passports with the preciseness about 1μm are briefly discussed. It is concluded that thickness measurement by the confocal type laser profile microscope is useful for passport examination.

Passport Examination, Confocal Type Laser Profile Microscope, Film Thickness

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