

NOTE

Modification of the aluminum for making offset printing plates

PREDRAG M. ŽIVKOVIĆ*, SLOBODAN JOVANOVIĆ*[#], KONSTANTIN I. POPOV** and
NENAD ILIĆ**

*Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, YU-11000 Belgrade and **Vinča Institute of Nuclear Sciences, YU-11000 Belgrade, Yugoslavia

(Received 19 October 1999, revised 25 August 2000)

Aluminum as the base of offset printing plates should make good contact with wetting agents and the light sensitive layer and should be resistant to wear and cracking. In order to achieve this, the aluminum is roughened and eventually anodized. A thin, electrochemically deposited chromium layer is used as the non-printing element in bimetallic offset printing forms. Chromium shows excellent wettability and wear resistance. The possibility of chemical deposition of chromium on aluminum from an alkaline solution is examined in this paper. The presence of chromium was confirmed and measured by EDAX. A difference in the spectral reflection characteristic between chromium-treated and non-treated specimens was also detected. An influence of a chromium layer on an aluminum surface was examined by water drop spreading. Chromium-treated samples showed better wettability than non-treated samples, but they are less wettable than anodized samples.

Keywords: aluminum, chromium, roughening, cementation.

INTRODUCTION

Offset printing forms consist of printing and non-printing elements. The non-printing elements are more hydrophilic than the printing elements. During the printing process, the printing form is first wetted by a wetting agent, consisting mostly of water. The non-printing elements are more wettable, so a thin water layer is formed on their surface. In the second step ink is applied onto the printing form, using rollers. An ink layer from the inkers splits only between the rollers and the dry surface of the printing form, *i.e.*, between the rollers and the printing elements. The ink does not normally cover the wetted, non-printing elements. The printing elements consist of a polymer, applied on an aluminum base. The non-printing elements are the parts of the aluminum base not covered with polymer. Anodization or chromium deposition can improve the non-printing elements.¹

The electrode potential of aluminum is lower than that of most other metals. Based on this fact, it could be assumed that aluminum could reduce and deposit most other metals. This is not an advantage in the case of plating aluminum in usual electrolytes, so aluminum is prepared for this by zincate or stanate (Alstan) treatment. As far as the authors know, till now there are no data about cementation of chromium ($\text{Cr}^{3+} + 3\text{e}^- = \text{Cr}$:

[#] Serbian Chemical Society active member.

−0.744 V). In this experiment an attempt was made to prepare a chromium layer on previously roughened aluminum, at room temperature from alkaline solutions.^{2–4}

EXPERIMENTAL

Previously roughened aluminum specimens were treated in different alkaline solutions of chromium chloride in order to chemically deposit a chromium layer onto their surfaces. A specimen for testing the analytical method was made by treating aluminum in an alkaline solution without chromium chloride. The composition of the surface layer was investigated by electron microscope using the EDAX procedure (energy disperse X-ray detector). The surface layers were analysed both qualitatively and quantitatively in order to confirm the possibility of making a chromium layer by this method.⁵ The method used in this experiment showed the composition of a 2 μm deep surface layer.

The plated specimens were examined also by scanning tunneling microscopy (STM).

The spectral reflection characteristics of specimens that were and were not treated with chromium ions were also determined. The measurements were performed using a narrowband spectrophotometer “Spektrolino – Gretag”. This spectrophotometer measures the reflectance of visible light (380–730 nm) in bands 10 nm wide. The incident light falls on the specimen at an angle of 45°, and the reflectance is measured at 0°.

The influence of chromium on the non-printing elements of the printing form was examined by drop spreading. Three series of samples were examined. A previously roughened aluminum foil 0.1 mm thick was used as a base for making the samples. This type of foil is the one normally used for making printing plates. The average roughness of this foil was $Ra = 1.5 \mu\text{m}$.

The dropper was 2 mm above surface. The drops fell under the gravitation force. The drop volume was determined by counting the number of drops necessary to fill a certain volume. The drop volume in this experiment was $V_d = 7.5 \text{ mm}^3$. The influence of physical forces on spreading because of the kinetic energy of the drop was minimized by selecting the minimal distance between the dropper and the surface.

The drop spreading method is very convenient relative method for comparing the wettability of different materials with the same wetting agent. By plotting the dependencies $S = f(V)$, where S is the wetted area and V is the volume of wetting agent, for different materials on the same diagram it is very easy to determine which material is more wettable.

RESULTS

Quantitative and qualitative analyses of chromium-treated and non-treated specimens show an increase of the chromium content of the surface layer of specimens that had been treated in alkaline solutions of chromium chloride.

It was not possible by STM to obtain a clear picture of the surface, of either on treated or on non-treated specimen. It could be assumed that the conductivity of the surface layer is very low, perhaps due to an oxide layer in both cases.

Chromium treated specimens reflect more light at all wavelengths.

The anodized sample has the highest wettability. The sample prepared with Cr^{3+} is more wettable than the non-chromed one. The sample that was not prepared in alkali had the lowest wettability. By anodized sample drop spreads totally even after the first drop. Chromium layer is more hydrophilic than spontaneously formed oxide layer on roughened surface.

After 24 h the difference in wettability between chromed and non-chromed sample increases. The main reason for increasing the difference is decreasing the wettability of non-chromed sample. The wettability of chromed shows no significant difference after 24 h.

The behaviour of roughened samples in case of aging, shows that chromium layer increases stability of non-printing elements on printing form. They keep their wettability after relatively long period (24 h), without additional treatment.

CONCLUSION

Based on performed experiments it could be concluded that cementation of chromium on aluminum from alkaline solutions at room temperature is possible.

Comparing the wettability of examined samples it could be concluded that chemical deposition of chromium increases water wettability of aluminum.

Chromium layer increases stability of plate material on aging, e.g., on non-printing element stability.

The highest wettability has anodized aluminum. Chromed samples are more wettable than samples that are just developed in alkaline media, but without Cr^{3+} ions.

ИЗВОД

МОДИФИКОВАЊЕ АЛУМИНИЈУМА ЗА ИЗРАДУ ПЛОЧА ЗА ОФСЕТ ШТАМПУ

ПРЕДРАГ М. ЖИВКОВИЋ*, СЛОБОДАН ЈОВАНОВИЋ*, КОНСТАНТИН И. ПОПОВ*
и НЕНАД ИЛИЋ**

*Технолошко-металуршки факултет, Београд и **Институт за нуклеарне науке, Винча, Београд

Алуминијумска основа штампарских форми за офсет штампу треба да добро везује течност за влажење и копирни слој и да буде отпорна на хабање и лом. Да би се обезбедило добро везивање копирног слоја и течности алуминијум се храпави и, евентуално, анодно оксидује, чиме се повећава и отпорност на хабање. Код биметалних плоча за формирање нештампајућих елемената користи се танак слој хрома који се наноси електрохемијским путем. Хром показује одлична својства у погледу отпорности на хабање и везивање течности за влажење. Могућност хемијског таложења хрома на алуминијуму из алкалних раствора описана је у овом раду. Присуство хрома у површинском слоју потврђено је и измерено поступком EDAX. Такође је утврђена разлика у спектралној рефлексiji између хромираних и нехромираних узорака. Утицај хромног слоја испитан је методом разливања капи. Највећу квашљивост показују анодно оксидовани узорци, затим хромирани узорци и, на крају, узорци обрађени само у базном развијачу. Слој хрома повољно утиче на отпорност алуминијумске основе на старење, с обзиром да се квашљивост старењем смањује много мање него код узорака обрађених само у базном развијачу.

(Примљено 19. октобра 1999, ревидирано 25. августа 2000)

REFERENCES

1. M. Kumar, *Standardizacija izrade i eksploatacija tiskovne forme za plošni tisak*, VGŠ, Zagreb, 1978, str. 121 (in Croatian)
2. K. M. Vansovskaya, *Metallischeskie pokrytiya nanesennye khimicheskim sposobom*, Mashinostroenie, Leningrad, 1985, pp. 90–92

3. S. Đorđević, M. Maksimović, M. Pavlović, K. Popov, *Galvanotehnika*, Tehnička knjiga, Beograd, 1997, pp. 388 (in Serbian)
4. S. S. Đokić, *J. Electrochem. Soc.* **143** (1996) 1300
5. P. R. Thornton, *Scanning Electron Microscopy*, Chapman and Hall Ltd., London, 1968.