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# Study on Property of Diamond Mobile Telephone Windows

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**Abstract**

a-C:H films were coated on windows of mobile telephone by RF plasma chemical vapor deposition equipment made in our company. Thickness of the coatings is about 0.7 micrometers and they have high hardness, low friction coefficient, good adhesion, high optical transparency and chemical inertness. Knoop hardness of the diamond-like carbon films on glass substrate is 2328 kg/mm$^2$. The adherence between films and substrate is good and shows to be 69 N by scratching test. The optical performance is improved obviously owing to coat the film on it. The index of the coated windows is 2.5, transmission of visible light is larger than 90%, and transmission of ultraviolet light decreases by 30% and the ultraviolet light can be obstructed obviously. The coated glass also has self-clean effect and decontamination ability. The films have hydrophobic character and the soakage angle of water drop is larger than 90 degrees. The windows have fog-proof ability owing to eliminate the capillary phenomena in the inner surface. The physics and chemical properties of the coated windows are steady. Study indicates that the performance of a-C:H coated mobile phone windows are improved notably on wear-resistance, corrosion-proof and optical properties and it is excellent mobile windows protective coatings.

## 1. Introduction

Modern mankind society has already entered into information ages, the mobile phone as a means of change information is increasingly coming into in people's life. However, the plastic windows and general glass windows are all along used for the mobile phone. The windows endure the weakness of easy wear, tear and scratching.

We try to use the a-C:H coatings [1], which have higher hardness, lower friction coefficient, good chemical inertness and high optical transparency, to improve windows quality of the mobile phone. A special RF-PCVD equipment has been developed in our company and technology parameters of deposition is choused to coat this film. The method can produce coatings with large area and high quality under low substrate temperature [2].

## 2. Experimental

Experiment equipment is the RF glow discharge system with fill up the gas mixture of carbon, hydrogen and argon [3]. The deposition condition is listed as follows.

Table 1 deposition parameters

| | |
|---|---|
| Vacuum | $3 \times 10^{-10}$ Pa |
| Radio-voltage | 1300-1600V |
| Anode current | 100 mA |
| Gate current | 20 mA |
| Gaseous composition | $CH_4$, $H_2$, Ar (1:1:1) |
| Time of deposition | 10-30 min |
| Substrate temperature | Room temperatre |

## 3. Results and Discussion

### 3.1 Hardness

Knoop hardness test was carried out by nano-indentation technology. The hardnesses of uncoated and coated glasses are 780 kg/mm$^2$ and 2328 kg/mm$^2$, respectively ; besides, it was found that there was obviously scratch on the surface of general glass but scarcely any change on the coated one by using scratching test with a number of rubbing between general and diamond-coated auto glass.

### 3.2 Wear resistance

Aissenberg reported first that hard carbon films could reduce the sliding friction. The friction coefficient of as-deposited diamond films in our laboratory is very small, $\mu$ =0.07 (See Fig.1). The higher hardness and lower friction coefficient of diamond films make the car glass good wear resistance. And There is scarcely any sign of wear and tear while the glass was rubbed at 3000 times with $\varphi$ 8 steel ball, 120 rpm, 2N load and 5 mm orbit radius.

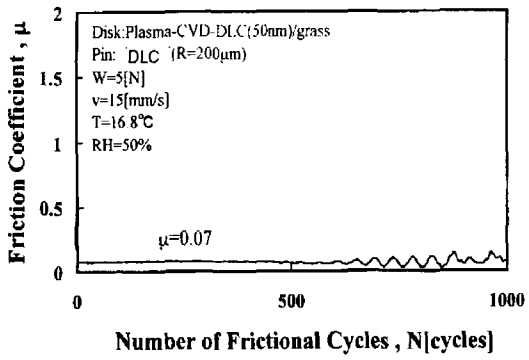


Fig. 1. Friction performance of DLC

### 3.3 Adherence between coatings and substrates

The adherence is the ability to keep the films and substrate no disjunction and characterizes the broken strength between films and substrate interface. Fig. 2 shows the scratching curve of diamond coated glass. The diamond indenter touches the surface and then forces a continuous load on. Simultaneously sound signal begins to launch and a flat straight signal begins to appears on screen and continues to the noise appear. The noise signal means the critical load has been obtained, and the coating begins to flake off. This critical load is just the adherence of film and substrate. Test indicates that the critical load is 69 N.

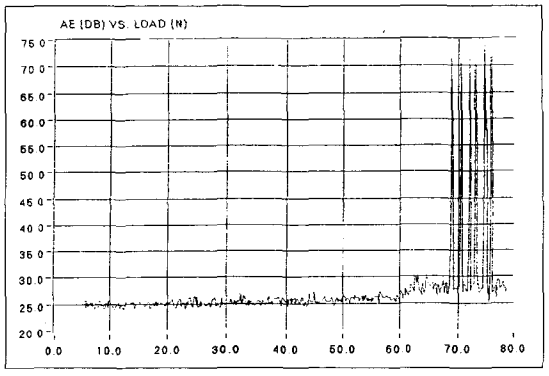


Fig. 2. Curve of Scratch Resistance(DLC)

### 3.4 Surface strain

Specification 0 $\mu$ l - 10 $\mu$ l, precision 0.2 $\mu$ l minim sampler were adopted, distilled water drop of 7 $\mu$ l was dripped on the surface of glass and the soakage angle of the water drop was larger than 90 degree.

### 3.5 Optical performance

The optical performance is improved obviously owing to coat the film on it. The index of the coated windows is 2.5, transmission of visible light is larger than 90%, and transmission of ultraviolet light decreases by 30 % and the ultraviolet light can be obstructed obviously. The coated glass also has self-clean effect and decontamination ability.

### 3.6 Corrosion resistance

The physics and chemical properties of the coated windows are steady. There was no change on the surface while it was soaked in 1 mole/l hydrochloric acid solution for 10 days and the it's acid proof was proven. To lay the windows under 300 ℃ environment for 3 days there was no change for the windows and its heat-resistant was proven.

## 4. Conclusion

The thin films of a-C:H was synthesized by means of radio-glow discharge at room temperature, the source gas is the CH mixture gas. It is indicated that the coatings have excellent quality for protecting the glasses, plastics and so on. Many customers in home and abroad (such as China, South Korea, Britain, USA and Netherlands) are interested very much in this kind of diamond mobile telephone windows. The TCL has adopted these windows and realized production value of 3 billions RMB Yuan per year.

## References

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