High performance suede-type polishing pad containing epoxy resin

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Abstract

Newly high performance final polishing pads containing epoxy resin were developed. First, epoxy resin was coated on a conventional urethane resin suede-type pad. This pad had a high performance, in particular, a removal rate of glass was over twice as high as those using untreated pad. However, this pad also had a problem relating to bond durability of epoxy resin. Therefore, a newly epoxy resin-impregnated suede-type pad was developed. It was found that the new epoxy-added pad had higher performance than the conventional suede-type pad, and that effect had been maintained after 3 hour of polishing.

1. Introduction

In our previous study, the new porous-type polishing pad has been developed [1], in which epoxy resin was adopted as a pad material instead of conventional urethane resin. And it has been reported that the new polishing pad exhibited a removal rate more than 70% higher than that of a conventional pad in a glass polishing. The reason of this high polishing performance is thought to be that affinity for slurry and stagnation ability of abrasives is improved by epoxy resin. These porous-type pads are used in 1st and 2nd polishing process, whereas a suede-type pad is widely-used in a final polishing process of hard substrate. However this suede-type pad has a problem in which removal rate is extremely-low. Therefore, in order to overcome this problem, the newly suede-type pad which has high polishing performance was tried to produce. But it had tried unsuccessfully to produce suede-type pad using epoxy resin. Because, when only epoxy resin was adopted as a pad material, microscopic-pore structure that was character of suede-type pad could not be formed. So, this study aims to develop the newly suede-type pad containing epoxy resin.

2. Epoxy-coated suede-type polishing pad

First, in a real simplistic way a new pads were produced, in which a thin film of epoxy resin was formed on conventional urethane resin suede-type pad by spray coating. In this section, a fluorine resin was used as a target for comparison that has a low affinity for slurry. Fig.1 shows the contact angles and sliding angles of resin films that were formed on metal plate by spray coating. The epoxy resin film has a low contact angle and a high sliding angle as compared to the urethane resin film, and the fluorine resin film has a countertrend of that. This result indicates that the epoxy resin film has a high affinity for slurry and a high stagnation ability of abrasives. Fig.2 shows SEM images of coated pad surface. The microscopic-pore structure can be observed in untreated pad surface (Fig.2(a)). These microscopic-pores were half-filled by coating of fluorine resin (Fig.2(b)) and a small amount of epoxy resin (Fig.2(c)), and almost filled by coating of a large amount of epoxy resin (Fig.2(d)).

Fig.3 shows polishing characteristic of these pads in a glass polishing. A removal rate of the coated pad by epoxy resin was over twice as high as those using untreated pad, and a surface roughness also decreased by half. In response, a removal rate of coated pad by fluorine resin that has a low affinity for slurry was decreased. As indicated above, although these excellent results were obtained, this coating method has a serious problem such as the coated epoxy film was removed quickly by friction of polishing, that is, this excellent effect disappeared quickly. Therefore in order to improve durability of these pads, the thickness of coated epoxy film was increased. As shown in Fig.4, not greater than 120 μm thickness of a film, the polishing characteristic was improved with increase of film thickness. But, when it came up to 200 μm, a removal rate was decreased. Because, as previous explained, the microscopic-pores were almost filled (as show in Fig.2(d)).

3. Epoxy-added suede-type polishing pad

In order to satisfy both of high performance and durability, a new method of manufacturing suede-type pad was developed, that impregnated base material of urethane resin with epoxy resin during wet process for making suede-type pad. It was found that suede-type pad which maintained a microscopic-pore structure could be produced by this new manufacturing method, when additive amount of epoxy resin was not greater than 10 phr.

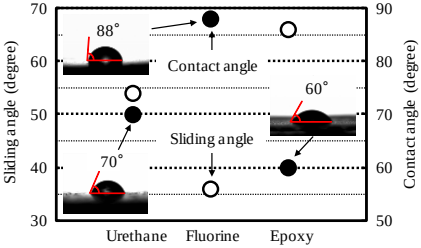
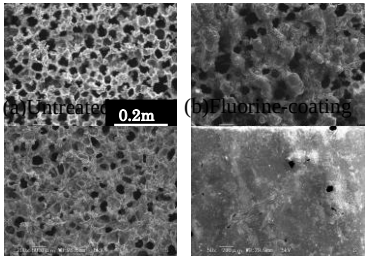


Fig.1: Contact angles and sliding angles of resin films



(c)Epoxy-coating [40μm] (d)Epoxy-coating [200μm]

Fig.2: SEM images of coated pads

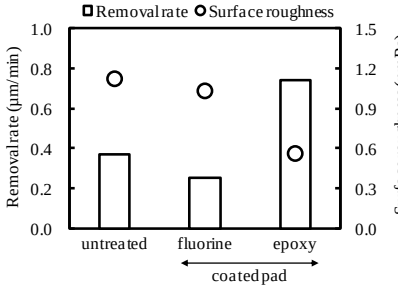


Fig.3: Comparison of polishing performance of coated pads

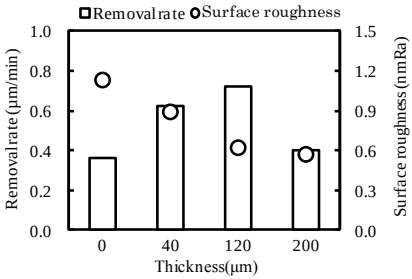


Fig. 4: Dependence of thickness of coated resin on the removal rate

And so, three suede-type pads that additive amount of epoxy resin was different were produced. Fig.5 shows FT-IR spectrum of these epoxy-added pads. A peak height that represents epoxy resin existence was increased with increase of additive amount. Additionaly, as shown in Fig.6, the contact angle was decreased and the sliding angle was increased with increase of additive amount. These results indicated that epoxy resin content in produced suede-type pad was increased with increase of additive amount of epoxy resin during wet process of making suede-type pad.

Fig.7 shows the polishing characteristic of these epoxy-added pads in a glass polishing. It was found that these epoxy-added pads had a high polishing performance, in particular, surface roughness was greatly-improved. But this high performance effect of epoxy resin was saturated at concentration of 5 phr. Fig.8 shows PSD profiles of polished glass surfaces using epoxy-added pad as compared

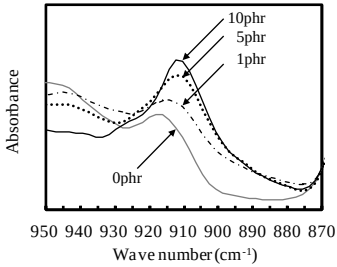


Fig.5: FT-IR spectrum of epoxy -added pads

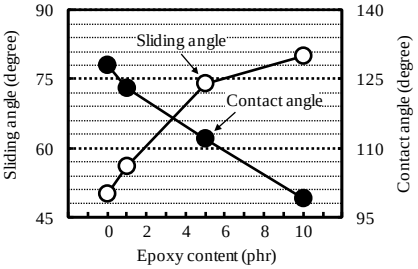


Fig.6: Relationship between epoxy content and sliding angle and contact angle

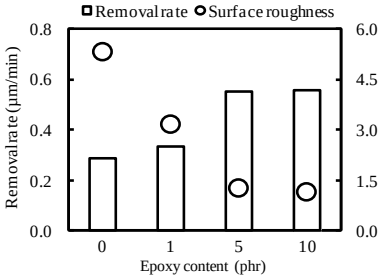


Fig.7: Relationship between epoxy content and polishing performance

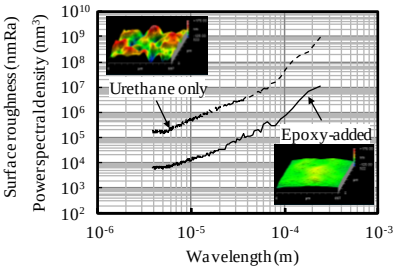


Fig.8: PSD profiles of polished glass surfaces

to conventional urethane pad, it was improved in all areas. And it was confirmed that these effects has been maintained after 3 hour of polishing.

4. Conclusion

Newly high-performance suede-type polishing pads were developed, that contained epoxy resin and had a microscopic-pore structure. In a glass final polishing using these pads, a removal rate and a surface roughness were greatly-improved.

Acknowledgments

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