CHEMICAL RESISTIVITY OF GRAPHITE MATERIALS FOR METAL POWDERS II

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Introduction

Carbon materials have very strong resistivities to acidic and basic chemical reagents. Many types of graphite materials are used in industry and many other areas. Sometimes, these materials are the cause of machine troubles. Previous studies [1, 2, 3] have shown the chemical resistivity of these materials for the liquid reagents and air.

In the present paper, we used 6 kinds of graphite materials and studied resistivity for oxidation in air for 8 kinds of metal powders at 450, 550 and 650 ℃ for 3 hours in air. The test pieces were checked for appearance, weight change, size, density, and SEM picture, before and after being heated in air for the test time and temperature. Results suggest that graphite resistivity for metal powders has been more thoroughly evaluated by our check list and materials should be selected according to the conditions they will be used in.

Experimental

Carbon materials(6): isotropic graphite 1 (**IG- 1T**), isotropic graphite 2 (**IG-2R**), highly graphitized isotropic graphite (**IG-3Q**), electrical high resistivity isotropic graphite (**IG-4U**): 2100 $\mu\ \Omega cm^{-1}$, high density graphite (**IG-5S**): 1.85 g/cm^{-3}, ultra-high density isotropic graphite (**IG-6P**): 1.90 g/cm^{-3} .

Test piece size: 10×10×60 mm with hole of 15×5 mm for metal powder mount. All Test pieces cut from one lot block.

Reagents: chemical reagent grade metal powders of vanadium(**V**), iron(**Fe**), cobalt(**Co**), copper(**Cu**), zinc(**Zn**), tin(**Sn**), tungsten(**W**), and lead(**Pb**).

Heated temperature and retention time: 450, 550 and 650 ℃, 3 hours.

Procedure: Test pieces were washed in an ultrasonic washer by pure water, and dried at 105℃ for one day. After pre-tests, 2 standard pieces and the 6 kinds of test pieces with the same kind of metal powder put into their holes were heated in the muffle furnace for the 3 hours at the test temperature. After cooling down, the test pieces were weighed, and after the metal powder was removed, they were washed in an ultrasonic washer with pure water. After drying at 105℃ for one day, each piece was tested for appearance, size, and SEM picture. The weight loss ratio and apparent density changes were calculated using the results.

Results and Discussion

The weight loss ratio was calculated by using the constant weight of pre- and after- heat treatments. Results of the weight loss for every test piece heated at the test temperature without metal powder are summarized in Figure 1. All pieces show 0.3 % or less weight loss after being heated at 450 ℃. And 0.6% or less weight loss after being heated at 550 ℃, except IG-5S (1.0%) and IG-6P

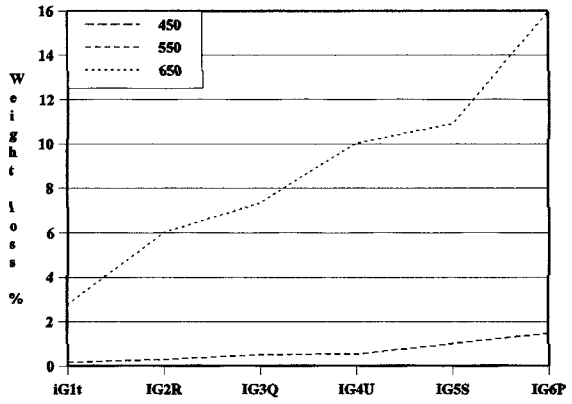

Fig. 1 Weight loss ratio of graphite materials heated at 450, 550, 650 ℃ in air for 3 hours. (%)

(1.5%). And 10 % or more weight loss after being heated at 650 ℃, except IG-3Q (7.2%), IG-2R(6.0%) and IG-1T (2.7 %). These are smaller values than graphite decrease of the last paper (ref. (3)) except IG-F(weight loss is 1.5%: high purity isotropic graphite). These results suggest that normal isotropic graphite has strong resistivity for oxidation in air, but high density and ultra-high density isotropic graphite has weak resistivity.

The weight loss ratio between samples with metal

powder loaded and those without metal powder loaded was calculated and the results summarized in Figure 2 .

Figure 2 shows three types of weight losses. Type 1: IG-1T, type 2: IG-2R, IG-3Q, and IG-4U and type 3: IG-5S and IG-6P.

In type 1, IG-1T is isotropic graphite. The weight loss at 650 ℃ in type 1 is 1% or less with the metal powders, except Pb(13.5 %). Pb shows the large weight loss of a graphite sample at every temperature. The small weight loss on all metal powders with IG-1T suggested metals has not played a important role for the oxidation that material in the air.

In type 2, IG-2R, IG-3Q, and IG-4U are isotropic graphite, highly graphitized isotropic graphite, high resistivity isotropic graphite, respectively. The order of weight loss at 650 ℃ is W(-4.4%)<V=Fe=Co=Cu=Zn=Sn (-2.6%) <<Pb (19.1%) for IG-2R, Zn(-5.7%)=W=Cu=V< Fe=Sn=Co(-2.0%)<<Pb(14.7%) for IG-3Q, and Fe(-6.7%) <V=Cu<Zn<W<Co=Sn(-1.6%)<< Pb(14.3%) for IG-4U. Weigh loss decreased with metal powder loaded, except Pb. These results suggested that at 650 ℃, metal powder blocks air diffusion into graphite pieces which in turn decreases apparent weight loss.

Type 3, IG-5S and IG-6P are high and ultra-high density isotropic graphite,.respectively. The order of weight loss at 650 ℃ in type 3 is Fe(-1.8%)<V(1.1%)=Co <Sn=W(1.4%)<<Zn(9.0%)<Cu(11.4%)<Pb(12.0%) for IG-5S, and Zn(-5.2%)<Cu<**Pb(1.1%)**<Fe(1.4%)<Co<Sn (5.4%)<<W=V(13.0%) for IG-6P. On IG-6P, at 550 ℃, Pb shows the most weight loss(3.2%), but at 650 ℃, Pb shows the least weight loss except Zn and Cu. Appearance of IG-6P heated at 650 ℃ without metal powder looks rough surface, but IG-6P heated at 650 ℃ with Pb looks rather smooth surface ? . Same phenomenon was observed on high density sample (ref. 3) May be Pb vaper block contact between air and graphite surface or some problems on binders.

Conclusions

1) Same type graphite materials but different kinds of raw materials and different procedures induce differences on resistivity for oxidation in air.
2) High purity isotropic graphite has strong resistivity for oxidation in air.
3) Apparent weight loss does not show the true relation-ship between metal powders and graphite materials.
4) Graphite materials which 10% or more weight loss at 650 ℃ without metal powder, are show complex resistivity for metal powders. It need more thoroughly evaluation by many characteristics.

References

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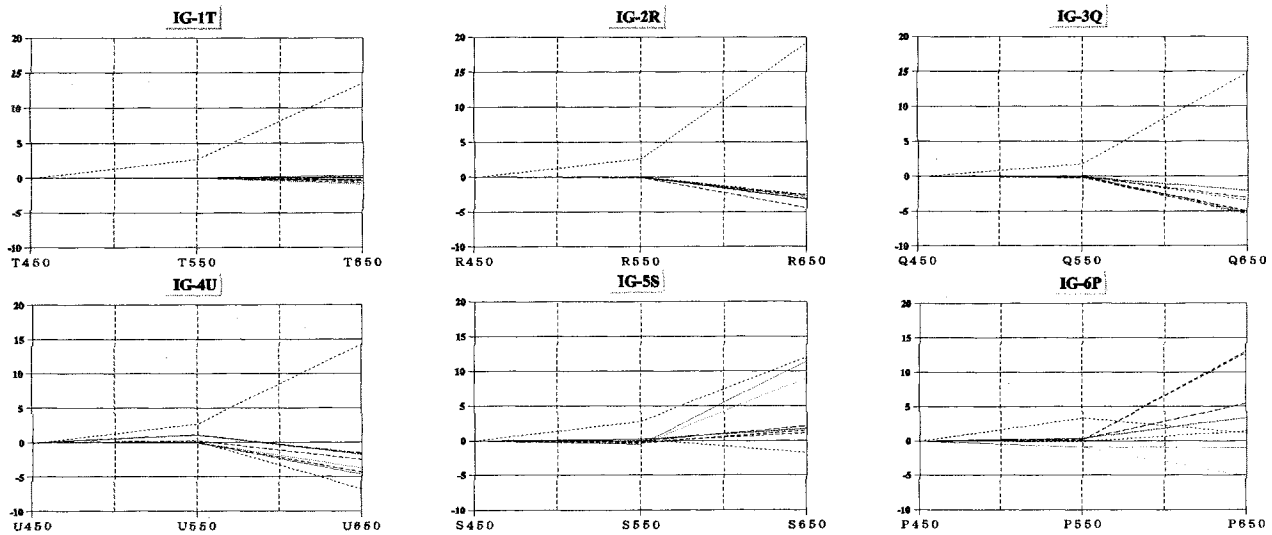

Figure 2. Weight loss of graphite materials heated at 650℃ for 3 hours in air with metal powders. %