Synthesis and Properties of Phosphated Epoxy Acrylate used for UV curable jet-printing ink

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1. INTRODUCTION

Phosphated epoxy acrylate and phosphated imid-epoxy oligomer/polymers were synthesized as curing agent of UV curable ink for manufacturing the ink-jet printed LCD color filter. With good properties of both epoxy and acrylic resins, epoxy acrylate is one of the most frequently used resins in UV curing system. Especially phosphated epoxy acrylate has reported to show not only good solubility in UV curable monomers and good compatibility with pigment as ink compositions, but also thermal and mechanical properties after curing. [1]

In present paper, four new phosphate-based oligomer/ polymers containing epoxy functional groups were synthesized as potential candidate binders for UV curable ink. The object of this study is to investigate the synthesis process and physical properties of these binders.

The properties of epoxy binders functionalized by phosphate were examined. NMR spectra and FT-IR spectroscopy were analyzed to identify the chemical shift and structure of the resulting oligomer /polymers. Molecular weight was observed by PY-GC Mass or MALDI-TOF, and thermal properties by thermo gravimetric analysis (TGA). To estimate the miscibility of synthesized binders as basis for the ink formation, they were tested along with different multifunctional monomers, 1,6 hexanediol diacrylate(HDDA) and triethylene glycol dimethacrylate (TEGA), in two kinds of solvent, di(propylene glycol) methyl ether acetate (DPMA) and di(ethylene glycol) monobutyl ether acetate (DGMA), in the presence of surfactant as dispersant, according to the practical contents of UV ink.

2. EXPERIMENTAL

Synthesis of Binders

Four binders were synthesized as shown in Fig.1.

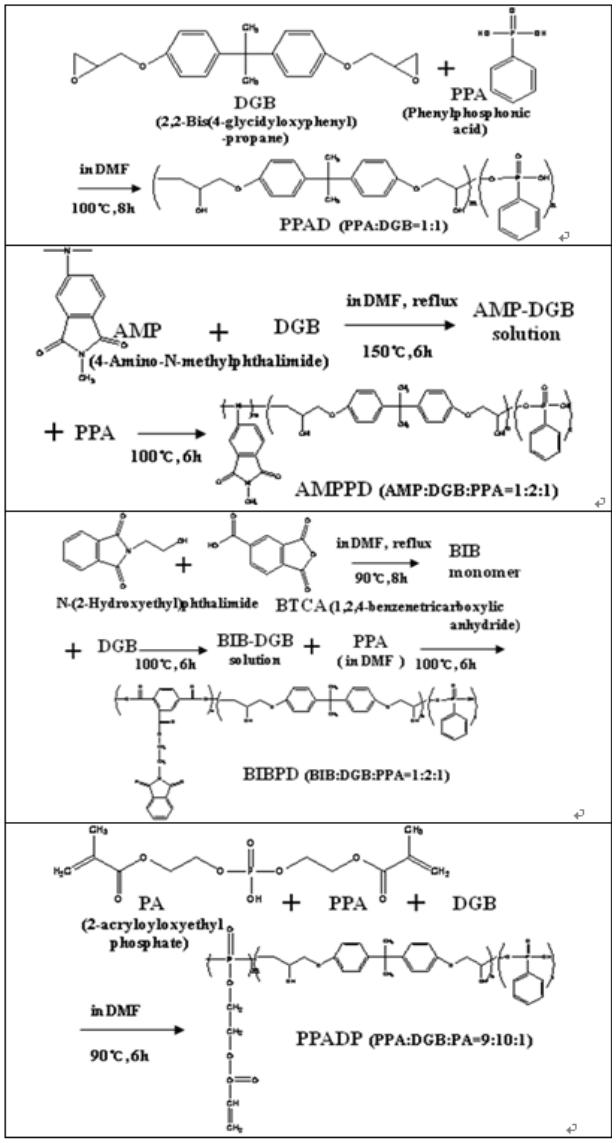

Fig. 1. The synthesis schemes of four phosphate epoxy binders, PPAD, AMPPD, BIBPD, and PPADP.

Preparation for Measurements

To prepare samples for thermal and mechanical property measurements and chemical structure identification, the solutions of PPAD, AMPPD and PPADP were poured into acetone to precipitate the polymers.

BIBPD copolymer was precipitated by methanol. All the precipitate was dissolved in solvent again and precipitated for further purification. Methanol and tetrahydrofuran(THF) were used as solvent for PPAD, AMPPD, PPADP and BIBPD, respectively. The precipitation solution was kept under chilly condition for a day before filtering.

The gel-like products were obtained in the case of AMPPD and BIBPD. These gel polymers were dissolved again in solvents and the solvent was evaporated under the reduced pressure at the temperature of 60~90°C to remove DMF and for solidification. PPADP and PPAD were converted immediately into oligomer/polymer during precipitation with solid content of approximately 30~40%. Finally the yellowish-brown polymeric products were obtained after filtration and then dried in a vacuum oven at 60°C for 24h.

On the procedure of synthesis and solidification, the solubility of binders in different solvents, such as water, methanol, acetone, THF, DMF, hexane and DMSO, was evaluated.

3. RESULTS AND DISCUSSION

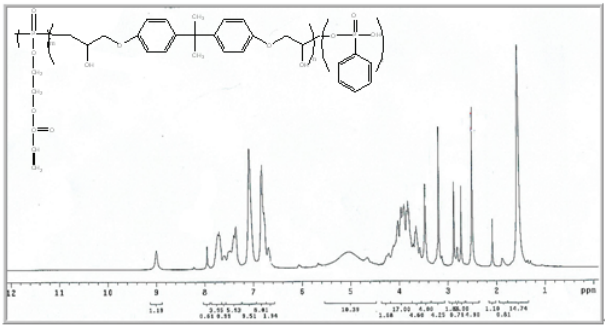

Fig. 2. H1-NMR spectra of Phosphate epoxy acrylate binder, PPADP

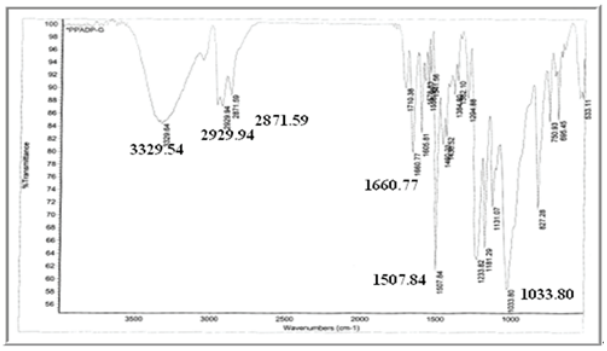

Fig. 3. FT-IR spectroscopy of Phosphate epoxy acrylate binder, PPADP

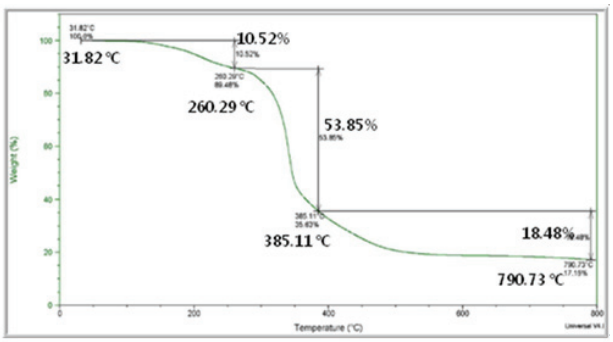

Fig. 4. TGA of Phosphate epoxy acrylate binder, PPADP

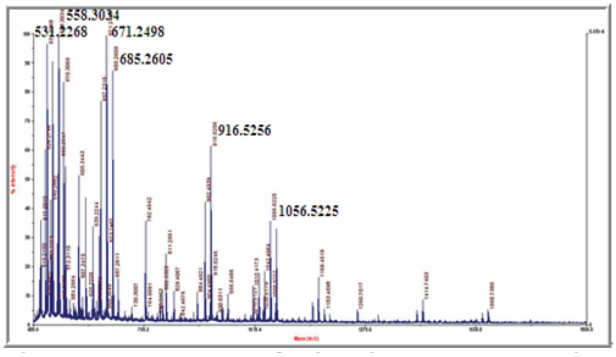

Fig. 5. MALDI-TOF of Phosphate epoxy acrylate binder, PPADP

4. CONCLUSIONS

PPADP, the phosphated epoxy-acrylate oligomer exhibited better solubility and affinity with monomer and solvent used for UV curable ink than any other binders. BIBPD, phosphated epoxy-imid polymer, showed poor solubility.

For the LCD color filter, high transparency and good thermal and mechanical properties of binder are required. Good compatibility of binder with monomer or solvent is a basic requirement for those good properties of color filter. Based on PPADP chemical structures, new types of binder is to be designed and synthesized.

5. REFERENCES

[1] C.J. Chang, M. H. Tsai, P. C. Kao, and H. Y. Tzeng; *Tthin Sold Filmes 516,* 5503-5507(2008).

[2] P. Kardar, M. Ebrahimi, S. Bastani, M. Jalili; *Progress in Organic Coating 64*, 74-80(2009)