Development and characterization of adjustable refractive index scattering epoxy acrylate polymer layers

T. Eiselt [a,d], J. Preinfalk [b], U. Gleißner [d], U. Lemmer [b,c], T. Hanemann [a,d]

[a] Institute for Applied Materials, Karlsruhe Institute of Technology, Germany
[b] Light Technology Institute, Karlsruhe Institute of Technology, Germany
[c] Institute of Microstructure Technology, Karlsruhe Institute of Technology, Germany
[d] Department of Microsystems Engineering, IMTEK / Albert-Ludwigs-University, Germany

Summary

The target of this project is to create optically diffusing films to increase the extraction efficiency of optical components. The layer should show the following properties:

- Homogeneous and transparent layer
- High scattering
- Adjustable refractive index

Introduction

- With a scattering layer more light couples out from the OLED

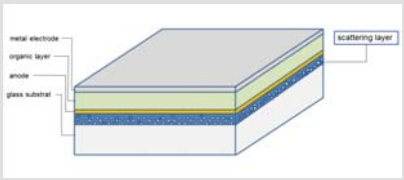


Figure 1: Overview of a OLED Stack

Materials

The three basic materials:

Table 1: Overview of the basic materials

Syntholux 291 EA	Bisphenol A glycerolate dimethacrylate	Sartomer SR348L

The additives are:

Table 2: Overview of the additive materials in the mixtures

Benzyl methacrylate	1,3-Butanediol dimethacrylate	Diphenyl(2,4,6-trimethylbenzoyl)phosphine Oxide

Viscosity behavior

- Viscosity is a key criterion for production method (screen printing or inkjet)
- Viscosity decreases with increasing temperature

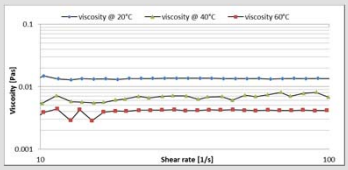


Figure 2: Viscosity behavior of developed TE-Bisphenol A Gly. ink

Adjustable refractive index

- Polarizable π-electrons influences the refractive index [1]
- 9-Vinylcarbazole has a high number of π-electrons
- Increasing 9-vinylcarbazole content in polymer, increases the refractive index

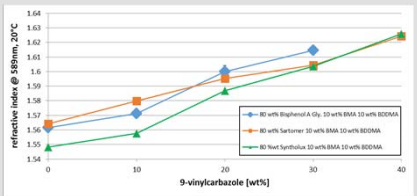


Figure 3: refractive index measurements

Production method

Ink-jet Pixdro LP50:

Piezo settings influence the **drop shape**, **drop size**, **drop velocity** and **target accuracy**.

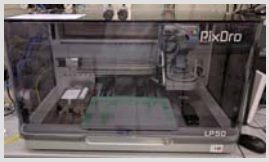
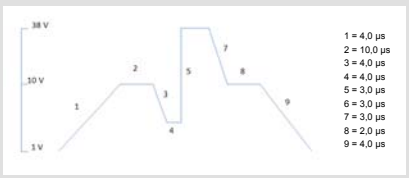


Figure 4: Inkjet printer Pixdro LP 50



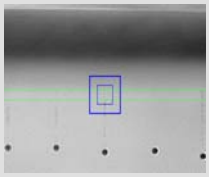


Figure 5: Piezo settings for the developed TE-Bisphenol A Gly. ink (left) and the resulting drop shape (right)

UV exposure (Hoenle, 405 nm, 10 min):

Figure 6: Inkjet printed scattering layer on a glass substrate

Optical characterization

Important factors are haze and transmission:

- Haze = Degree of scattering in %

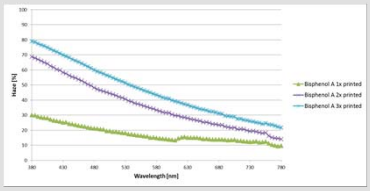


Figure 7: Haze measurements consists out of TE-Bisphenol A Gly. ink

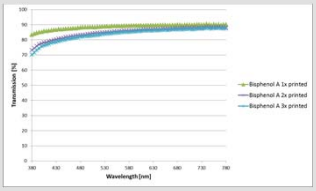


Figure 8: Transmission measurements consists out of TE-Bisphenol A Gly. ink

Conclusion

A simple method to produce highly diffusing optical layers with high refractive index has been presented. These optical films can be used to increase the extraction efficiency of optical components. Films with a refractive index of 1.62 at 589 nm and 20°C were successfully produced.

Acknowledgements

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References

[1] T. Hanemann and K. Honnef, "Viscosity and refractive index adjustment of poly (methyl methacrylate-co-ethyleneglycol dimethacrylate) for application in microoptics." Polymers for Advanced Technologies 26.4 (2015): 294-299.

Contact:
Mr. Thomas Eiselt
E-Mail: Thomas.Eiselt@kit.edu