The Dispersion of Zirconia nanoparticles : ZIRCOSTAR

Kunio Takahashi, Tomoyuki Yao, Junya Kimura and Hironobu Hashimoto

NIPPON SHOKUBAI CO., LTD., 5-8 Nishi Otabi-cho, Suita, Osaka 564-0034, Japan
kunio_takahashi@shokubai.co.jp

1 INTRODUCTION

Recently, the LCD and OLED display market demand concerning high refractive index materials increases rapidly. The required refractive index exceeds the upper limit of organic materials that can attain, therefore the research area of hybrid materials constituted from high refractive index inorganic nanoparticles and organic materials is currently hot topic. Zirconia nanoparticles have been paid attention as candidates of the high refractive inorganic material, because zirconia itself has high refractive index ranging from 2.0 to 2.4 and does not have photocatalytic activity like titania.

We, Nippon Shokubai Co., Ltd., have developed new dispersion of zirconia nanoparticles, ZIRCOSTAR, by our original technology. The zirconia nanoparticles of ZIRCOSTAR have good dispersibility. ZIRCOSTAR can be applied to coating materials, molding compounds and etc. which require transparency and high refractive index simultaneously. We have established the manufacturing process of ZIRCOSTAR recently. ZIRCOSTAR has been started to use for industrial coating materials for optical films.

2 FEATURES OF ZIRCOSTAR

Structural properties of the zirconia nanoparticles of ZIRCOSTAR are as follows:

- Ultra-fine particles controlled nanoscale (Figure 1).
- Surface area of the zirconia nanoparticles completely covered by surface modifiers.
- UV curable functional groups introduced on surface area of the zirconia nanoparticles.

In a high concentration range, generally, the dispersibility of ordinary metal oxide nanoparticles is unstable and the aggregation of the nanoparticles occurs. On the other hand, ZIRCOSTAR attain good dispersibility in various organic solvents, monomers and resins even at high concentration by above three structural features.

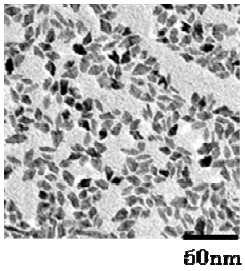

Figure 1: TEM image of ZIRCOSTAR

Figure 2: Dispersion in benzyl acrylate (Type 2)

	Type 1	Type 2 (Nonsolvent type)
Dispersion medium	MEK	Benzyl acrylate
Particles content	70 wt%	80 wt%
Viscosity (at 20℃)	10 mPa･s	1500 mPa･s
Refractive index	1.53	1.67
Average particle size	11 nm (Dynamic light scattered method)	

Table 1: Examples of ZIRCOSTAR

As shown in Figure 2 and Table 1, ZIRCOSTAR shows good transparency at high concentration. The data of average particle sizes supports good dispersibity which is a reason of transparency. Also, low viscosities of ZIRCOSTAR are very important for workability as film coating materials.

	Example A	Example B	Example C
Particles content	0 wt%	50 wt%	80 wt%
Refractive index	1.51	1.65	1.74
Transparency	90 %	90 %	90 %
Haze	0.8 %	0.8 %	0.8 %

【Evaluation conditions】

・Formulation
Dsipersion sample: Type 1
Binder (Acrylic monomer): Pentaerythritol triacrylate
Photo initiator: Irgacure 184 (1.5 wt% / solid)
・Cured condition: 5 min dried at 80℃
⇒ UV Cured with 1500mJ/cm^2 irradiation
・Cured film thickness: 5 μm

Table 2: Typical properties of the film using ZIRCOSTAR

Increasing ratio of zirconia nanoparticles makes refractive indices of the films high (Table 2). Also, transparency and haze values are kept same level even increasing ratio of zirconia nanoparticles. These data suggest high dispersibility of ZIRCOSTAR.

3 SUMMARY

We have developed new dispersion of zirconia nanoparticles with good dispersibility, ZIRCOSTAR. The particles of ZIRCOSTAR realize the materials which have high refractive index and transparency even at high concentration simultaneously. This outstanding character cannot be accomplished by either organic materials nor conventional nanoparticles. ZIRCOSTAR is useful for optical materials such as coatings, films, lens and so on.