Topics

Improvement in pressure-sensitive paint by employing metal oxide-polymer composite binder

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Pressure-Sensitive Paint (PSP)[1], which can provide a visual pressure distribution over the surfaces of parts in a fluid, is advantageous in making non-destructive, non-contact measurement of surfaces including those on mobile bodies. Therefore, this paint is attracting attention as an effective technique of measuring pressure distribution on a model aircraft, propeller and rotary wings in a wind tunnel.

PSP utilizes a phenomenon of oxygen quenching of phosphorescence of luminescent molecules irradiated with ultraviolet rays. Since the oxygen concentration in the air is proportional to the pressure, pressure distribution can be assessed by measuring the luminescence intensity distribution. Conventional PSP consists of luminescent molecules and silicone polymer and other binders. However, the low oxygen permeability in the polymer phase presented a problem of incapability of detecting minute pressure variation. The current structural and composite improvement on the binder material has succeeded in improving the pressure sensitivity and luminescence intensity.

The composite PSP has a structure in which luminescent molecule : platinum octaethylporphyrin (PtOEP) is distributed in the composite binder of siloxane to which hydrophobic phenyl group and silica particles have been added (**Fig. 1**). Introduction of hydrophobic group to siloxane suppresses aggregation of PtOEP molecules to realize high luminescence intensity. Pressure sensitivity follows the Stern-Volmer relation, and the higher the pressure, the lower the luminescence intensity drops (**Fig. 2**). Addition of silica particles of 10wt% increases oxygen sensitivity and improves the pressure sensitivity, simultaneously improving luminescence intensity with the light scattering effects (1.3 times and 3.4 times), respectively (**Fig. 3**). By optimizing the structure of oxide particles and the functional group of the oxygen penetrable polymer, pressure sensitivity can be further improved to realize the measurement of minute pressure distribution on the surface of vehicle bodies, etc.

Reference

1) Keisuke Asai : J. of Visualization Soc. of Jpn, 18-69 (1998), 97

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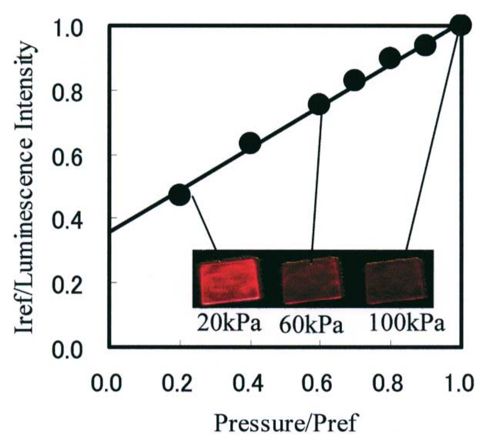

Fig. 2 Luminescence Intensity as a function of pressure, where Pref is the ambient pressure and Iref is the luminescence intensity at ambient condition. Insert : Luminescence image of a PSP coated glass plate at three levels of pressure. Excitation : Xe Lamp, *l*=380nm, Light Emission : *l*=645nm.

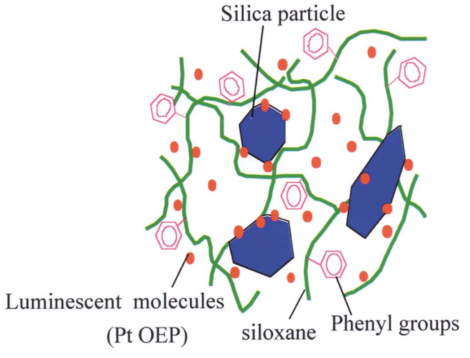

Fig. 1 Structure model of pressure-sensitive paint using silica doped phenylsiloxane and Platinum Octaethylporphyrin (PtOEP).

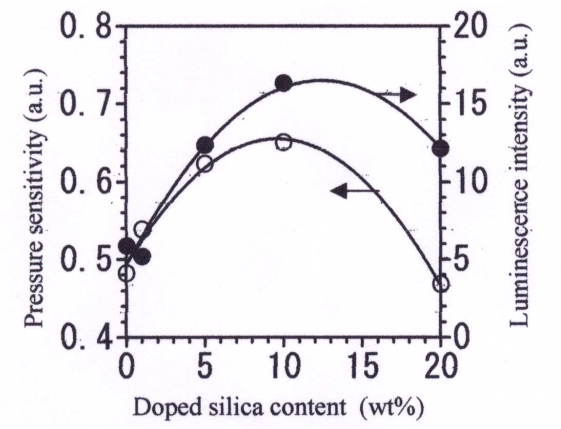

Fig. 3 Variation of pressure sensitivity and luminescence intensity of PSP with doped silica content.