Enhancing the Conductivity of Ceramic Coatings on Organic Glasses

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Poster Session

Problem:

Organic glasses, such as polycarbonate and polymethyl methacrylate, are used to create glazing of various purpose. This is determined by a higher strength of such glasses as compared to inorganic glass, with lower weight and required transparency. However, applications of polymeric glasses are limited by their insufficient wear resistance. This may lead to decreasing their transparency during operation. To increase the abrasive wear resistance of organic glasses, coatings are used that have high adhesion to polymeric glass, wear resistance, UV stability, cyclic temperature drops, and transparency kept at the level of at least 70÷80%.

Purpose:

performing the comparative analysis of possible ways to enhance the conductivity of abrasive wear resistant ceramic coatings on organic glasses, maintaining their optic transparency.

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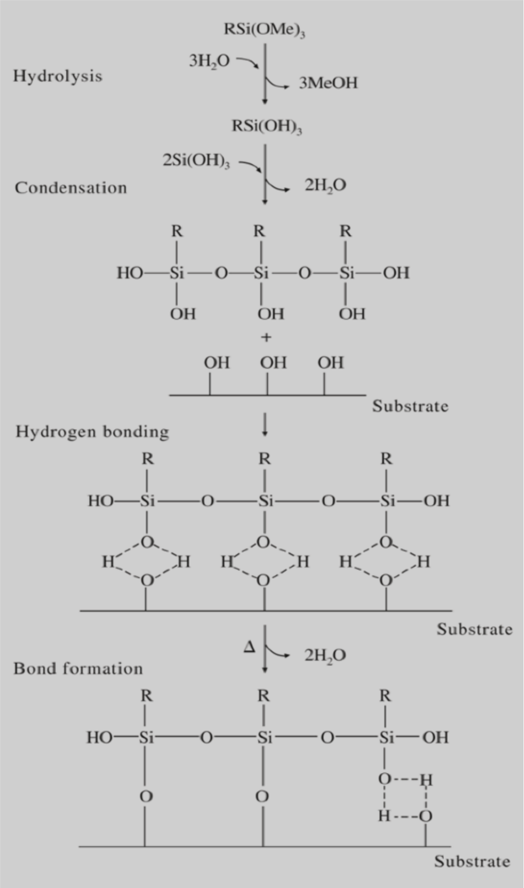

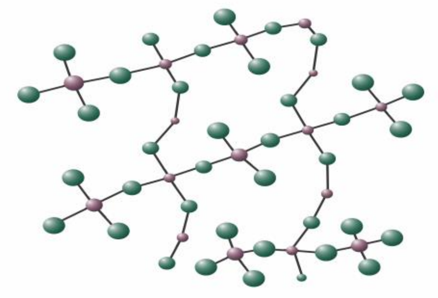

Ceramic coating on the polycarbonate

РОССИЙСКАЯ ФЕДЕРАЦИЯ

ПАТЕНТ

НА ИЗОБРЕТЕНИЕ

№ 2738241

ПРОЗРАЧНАЯ ПОЛИМЕРНАЯ КОМПОЗИЦИЯ, СТОЙКАЯ К ЦАРАПАНИЮ

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Sample No.	Mass additives, %	% wt of particles	Hardening time at room temperature, h	Note
1	0	0	24	Quaternary ammonium salt
2	20	0	1	N-benzyl-N-aminoethyl-3-aminopropyltrimethoxysilane-hydrochloride
3	3	0	24	Quaternary ammonium salt
4	5	0	24	Quaternary ammonium salt
5	10	0	24	Quaternary ammonium salt
6	15	0	24	Quaternary ammonium salt
7	20	0	24	Quaternary ammonium salt
8	30	0	24	Quaternary ammonium salt
9	3	0	1	Quaternary ammonium salt
10	5	0	1	Quaternary ammonium salt
11	10	0	1	Quaternary ammonium salt
12	15	0	1	Polyaniline
13	20	0	1	Polyaniline
14	30	0	1	Polyaniline
15	5	5	24	Conductive ATO particles, China
16	5	10	24	Conductive ATO particles, China
17	0	5	1	Conductive ATO particles, China
18	0	10	1	Conductive ATO particles, China
19	0	1	1	Applying the coating immediately upon mixing; Conductive ATO particles, China

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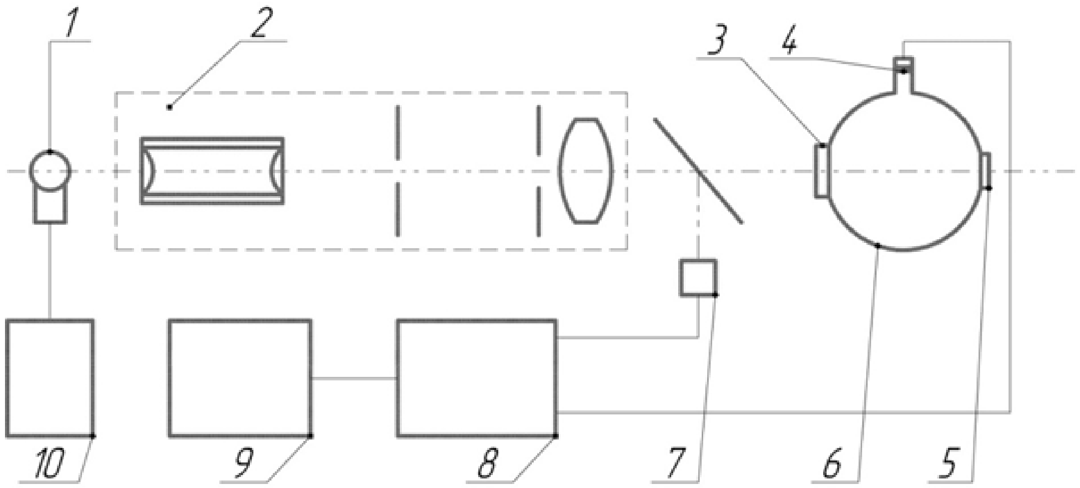

Optical characteristics measurement

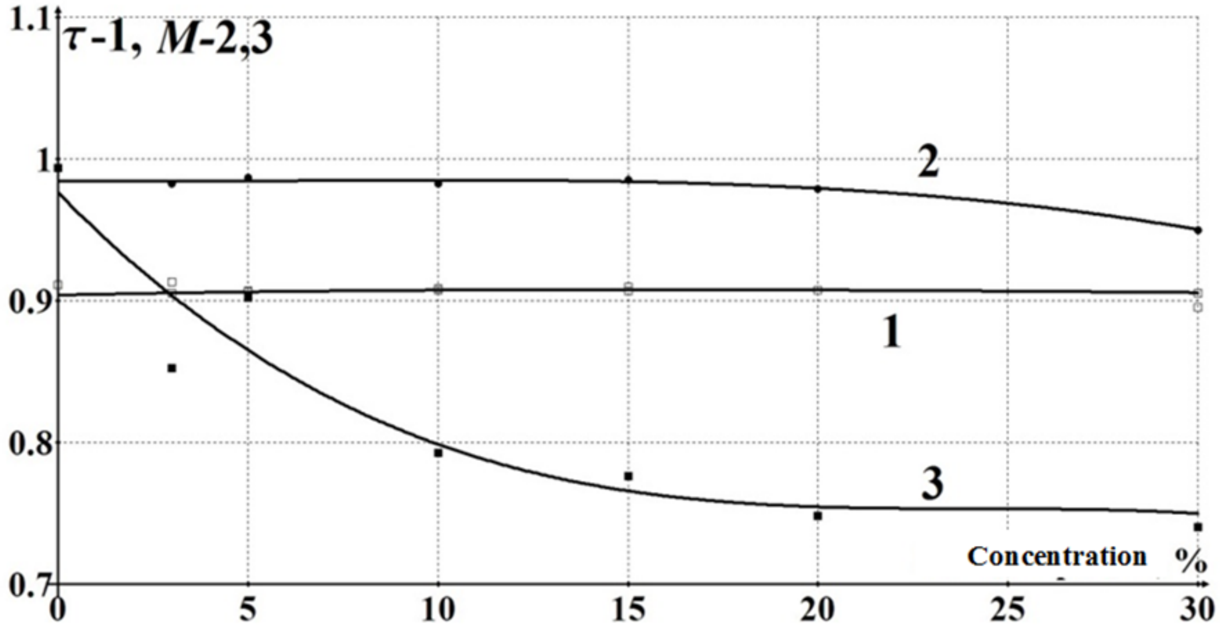

Fig. 2. Dependence of transmittance factor, τ, and transparency, M, on the concentration of salts in the samples: 1 – transmittance factor for samples 1-14; 2 – transparency for samples 1 and 3-8; 3 – transparency for samples 9-14.

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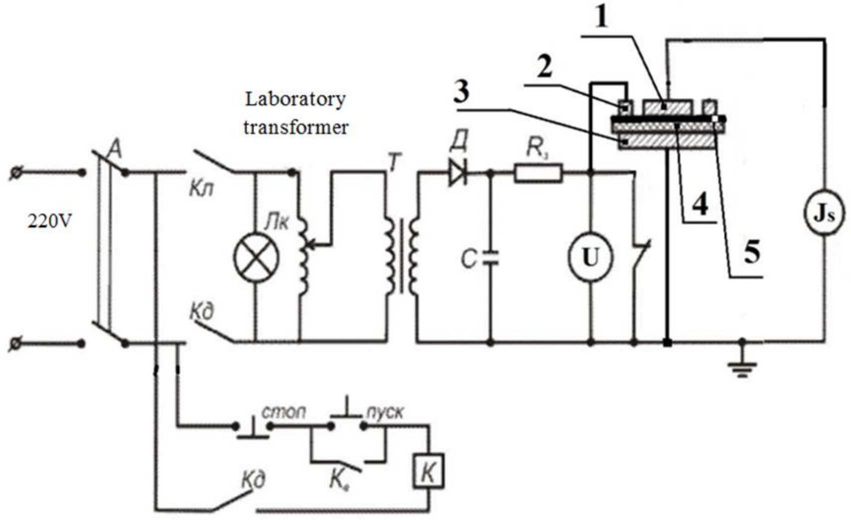

Fig. 1. Schematic structural diagram.

Resistance measurement

Sample No.	Surface specific resistance, Ohm	Sample No.	Surface specific resistance, Ohm
1	$> 3 * 10^{11}$	18	$> 3 * 10^{11}$
2	$> 3 * 10^{11}$	19	$> 3 * 10^{11}$
3	$> 3 * 10^{11}$	20	$> 3 * 10^{11}$
4	$> 3 * 10^{11}$	21	$> 3 * 10^{11}$
5	$> 3 * 10^{11}$	22	$> 3 * 10^{11}$
6	$> 3 * 10^{11}$	23	$> 3 * 10^{11}$
7	$> 3 * 10^{11}$	24	$> 3 * 10^{11}$
8	$> 3 * 10^{11}$	25	$4.4 * 10^{9}$
9	$> 3 * 10^{11}$	26	$3.1 * 10^{10}$
10	$> 3 * 10^{11}$	27	$6.2 * 10^{10}$
11	$> 3 * 10^{11}$	28	$3 * 10^{11}$
12	$3 * 10^{6}$	29	$> 3 * 10^{11}$
13	$2 * 10^{6}$	30	$1.1 * 10^{10}$
14	$6 * 10^{5}$	31	$1.5 * 10^{8}$
15	$> 3 * 10^{11}$	32	$3 * 10^{11}$
16	$> 3 * 10^{11}$	33	$1.6 * 10^{10}$
17	$> 3 * 10^{11}$	34	$3.8 * 10^{9}$

Conclusion

Reducing the surface resistance leads inevitably to lower transparency and/or abrasive wear resistance when using the methods proposed to enhance the conductivity of the dielectric organosilicon coating. At the same time, considering the contact mechanism of conductivity when filling a dielectric material with conductive particles, there is a threshold concentration of these particles in the matrix, starting from which conductivity can be obtained that is close to that of the material of the particles introduced. Thus, by all appearances, the methods studied herein have lower conductivity bounds at maintaining the high transparency and abrasive wear resistance of the organosilicon coating. An organosilicon lacquer formulation was obtained ensuring the compromise values of electric coducvity, optic transparency, and abrasive wear resistance: Basic organosilicon lacquer Quartz; submicron particles of antimony oxide introduced into the basic lacquer upon pre-filtering through a filter paper with openings sized 1 μm; and antimony quaternary ammonium salts. The following values were obtained for such coating: Surface resistance: $3.1*10^{10}$ Ohm; transparency: 0.9442; abrasive wear resistance higher than that of the the basic polycarbonate (GOST 29298-2005); and adhesion scoring 1 point according to GOST 15140-7.

Thank you!

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