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PROCESS FOR THE PRODUCTION OF PROTECTIVE LAYERS ON OPTICALLY ACTIVE SURFACES

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The present invention relates to a process for the production of protective layers on optically active surfaces. By optically active surfaces are hereby to be understood the surfaces of optical lenses, prisms, plates etc., consisting of different sorts of glass or other transparent materials such as calcspar, fluorspar, rock salt, sylvine, quartz, quartz glass and similar minerals, or also of synthetic materials such as artificial resins, as well as optically active metal surfaces of silver, aluminium and the like, such as the surfaces of metal mirrors.

Such protective layers have the purpose to make optically active surfaces resistant against the influence of the atmosphere, as well as against chemical agents, such as acids or bases and the like and to protect them against mechanical damages.

Protective layers which can be used for optically active surfaces, especially for optical glass lenses consisting of highly sensible glass sorts, must fulfill a number of conditions. The layers must be transparent and may not possess colours within the range of the spectrum used. They may not influence the optical properties of the respective glass lenses and the like, i. e. they must be in general very thin. Nevertheless they must strongly adhere to the respective optically active surface and may not loosen under the influence of especially high or especially low temperatures or sudden temperature changes. Moreover they must possess such a hardness that the respective optically active surfaces can be cleaned in the usual way and by usual means without that scratches and the like result thereby.

It is known to coat optically active surfaces with protective layers of organic substances such as transparent artificial resins or varnishes. The principal disadvantage of such protective layers of organic substances lays in the fact that they have only a small chemical resistance; besides, protective layers of organic substances show after a certain time changes of colour and frequently become turbid, so that the effect of the optical devices produced thereby is lowered.

To produce protective layers on optically active surfaces according to the invention, these surfaces must be first thoroughly cleaned so that layers of dirt, especially layers of greasy dirt, are removed. After that they are wetted with the solution of a substance out of which an undissoluble compound of the general formula $SiO_2.x\,H_2O$, in which x means any number, can be precipitated. So for instance, they can be wetted with an aqueous solution of sodium silicate, obtained by dissolving an alkali silicate, containing 1 mol of alkali per 3,6 mols of silicic acid, in 28 l. of distilled water. The surfaces wetted with the solution of the silicate are for the precipitation of the silicic acid or the silicic acid hydrate, then preferably after a preliminary drying, treated with the solution of an anorganic acid, such as sulphuric acid, hydrochloric acid, phosphoric acid, nitric acid and the like, or with the solution of an organic acid, such as formic acid, acetic acid, propionic acid, lactic acid, oxalic acid, tartaric acid, citric acid, benzene sulphonic acid and the like or with the solution of an acid salt such as potassium bisulphate, sodium bisulphite and the like. When using polysilicates instead of simple silicates the precipitation of the silicic acid can be also obtained by means of organic solvents such as ethyl alcohol. The surfaces wetted with the respective silicate are subjected for so long a time and to so energetic an action of the above-named agents, until the whole silicic acid is precipitated. Afterwards the salts, produced out of the basic components of the silicate used and of the acid or the acid salt applied for the precipitation, are thoroughly washed out so that the protective layer remaining on the optically active surfaces consists practically only of silicic acid or of silicic acid hydrate. The wetting of the optically active surfaces with the solution of the silicate can be obtained, for instance, by immersion, sprinkling or spraying.

The silicic acid can be used also in an other form, so for instance, as silicon tetrachloride. The surface to be coated is, for instance, wetted with silicon tetrachloride. The precipitation of the silicic acid on the optically active surface is then obtained by treatment with water, alkali or the like.

Finally the silicic acid can be used also in the form of organic complex compounds, as for instance of dimethylamino guanidine silicate.

In accordance with the desired layer thickness the treatment according to the invention can be carried out once or several times; besides by several repetitions of the treatment an increased thickness of the protective layer can be also obtained by using appropriate concentrations of the solution with which the respective surfaces are wetted.

To enhance the mechanical resistance of the layers obtained on the optically active surfaces they can be subsequently submitted to a thermical treatment such as a heating at high temperatures, amounting, for instance, for articles of glass to 200–750° C. When the deposition of the layers is obtained by several repetitions of the treatment according to the invention, then the heating is preferably carried out after each treatment.

The mechanical resistance, for instance the scratch resistance, of the layers obtained by the process according to the invention, can be greatly increased when dioxane or furane derivates, such as furfurol are added to the solutions with which the surfaces to be treated are wetted. So for instance, 10 cc of dioxane can be added to the above-named solution. Thereby the hardness of the layers is greatly enhanced.

The protective layers obtained by the process according to the invention have not only a strong adherence, but are also absolutely resistant against the action of the usual acids, with the exception of hydrofluoric acid and hot phosphoric acid, as well as against the action of the atmosphere. They are unsensible against the influence of temperature.

To ease the obtaining of protective layers of an absolutely constant thickness it is recommendable to centrifuge the surfaces wetted with the treatment solution before the precipitation of the silicic acid is carried out. For this aim the surfaces, wetted with the solutions of sodium silicate or the like, are in the wet condition transferred in a centrifuge. In accordance with its number of revolution and the duration of the centrifugal treatment, layer thicknesses of absolutely determinated value can be obtained.

The centrifuge used possess preferably exchangeable liners, which are provided with a greater number of devices to fasten the objects to be treated. The said objects are placed as far as possible from the axis of rotation of the centrifuge, to avoid that those points of them which are remotest from the axis are subjected to a far greater centrifugal force than the points, which are nearer the axis.

It has been found that it is favorable to enhance the mechanical effect of the centrifugal treatment by the addition of substances to the solutions with which the objects to be treated are wetted, which diminish their surface tension. So for instance, soaps, alkylated aromatic sulphonic acids such as isopropyl naphthalene sulphonic acid and other known agents for diminishing the surface tension can be added to the treatment solutions. When using the isopropyl naphthalene sulphonic acid the addition of 15 cc of a saturated solution per liter of the treatment solution has been found especially appropriate. At the application of such a solution the number of revolution of the centrifuge is preferably so regulated that the objects to be treated have a mean circumferential speed of between 10 and 100 m per second at a radius of the circuit of 20 cm. Hereby a duration of the centrifugal process of 1–3 minutes has been used.

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