ONE- OR MULTI-LAYERED LAYER ELEMENTS APPLIED TO SUPPORTS AND THEIR PRODUCTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to layer elements applied to supports, which elements can be one- or multi-layered. The individual layers are first applied to a modified support from a solution of organic materials suitable for the layer formation and then applied on top of the previous layer in each case. Thus, construction of these layer elements takes place by sequential physisorption (salt formation). Accordingly, the invention also relates to the production of these layer elements.

Coated supports have a variety of uses in industrial technology. For example, the frictional properties of materials can be adapted to a desired purpose by a suitable treatment of their surface. Furthermore, they can be a protective film for the supports underneath in order to preserve their special surface properties. However, coated supports have recently found application in particular in structural components for optical communication technology and as electronic and optoelectronic information stores.

In particular for electronic and optical purposes, it is necessary to produce extremely thin, defect-free multilayered coatings whose layers have a high degree of order and an adjustable, substantially homogeneous layer thickness, it being desired of this high degree of order also to be maintained in the range of a large number of coating layers.

Thus, the thin films produced from suitable organic materials are the basis of ordered, defect-free systems on the molecular level, such as are required, for example, for

optical applications (guided transmission of low attenuation, for example optical waveguides having nonlinear optical properties),

electrical applications (electrical conductors of high anisotropy, for example one-dimensional or two-dimensional conductors in the area of molecular electronics),

"host lattices" for defined incorporation or specific binding of functional groups or molecules.

Further areas of application of such layer elements applied to supports are the modification of electrodes and their use in the catalysis of chemical reactions, and sensors, biosensors, surface treatments (for example coating of cationic surfaces, such as interior surfaces of tubings, with heparin to increase biocompatibility).

2. Description of the Related Art

The previously most investigated method for producing ultra-thin films and multi-layered layers is the conventional Langmuir-Blodgett (LB) method. In this method, the layer construction takes place by sequential transfer of monolayers from a water surface to a solid substrate. This method is distinguished by a relatively high apparatus outlay, which nevertheless only allows small supports to be coated. The organic material for building up the layers must be sufficiently spreadable on the water surface.

Furthermore, the attempt has been made to take carboxyl-containing supports, as can be produced, for example, by oxidation of polyethylene supports, as the basis of uniform coating. To this end, for example, long-chain carboxylic acids were applied from a solution to the support described by means of calcium ions. The calcium ions provide an ionic bond between the carboxyl groups of the support and the carboxylic acid applied. Since dicarboxylic acids and calcium ions when applied from a solution would lead immediately to an insoluble and no longer usable salt precipitate, only monocarboxylic acids can be used. If it were decided to apply further layers onto this first layer, first the non-functionalised part of the carboxylic acid molecule which points away from the carboxyl group would have to be functionalised in order to allow the build up to continue. A still further attempt was made to produce a multi-layered layer construction by alternating reaction of 1,10-decanediol bisphosphate with its zirconium salt or by alternating reaction of 1,10-decanediol bisphosphate with zirconyl chloride. These attempts ended after about 8 layers, because by then the surface showed too severe a defect for an ordered further layer build up. In the case where zirconyl chloride was used, the change from the inorganic crystal lattice to the organic crystal combined therewith can be assumed as the source of the defect formation.

Furthermore, it has been observed that where the attempt is made to coat an ionically modified support surface with organic molecules provided on both α, ω ends with ions, in which the ions have the opposite charge, defects were caused by the fact that many of the organic molecules provided on both sides with ions do not arrange themselves perpendicular to the support surface thus forming a bond with the support only with one ionic end of this molecule, but arrange themselves flat, i.e. parallel to the support surface, and form a bond with the ionic support surface with both ionic ends of the molecule. Thus, on the one hand, no functional group (in this case the second ionic group of this organic molecule) remains for further build up of layers and, on the other hand, such an organic molecule adsorbed in an undesired manner parallel to the support surface covers the ionic groups of the support underneath which are present between the two binding sites formed and prevents these covered ionic groups from forming ordered layers.

Finally, organic monolayers can be formed by adsorption of organic mercapto compounds, for example on gold surfaces (self-assembly technique).

Accordingly, there was still a demand for layer elements applied to supports which have a high degree of order without the defects described. Such layer elements applied to supports should furthermore have a greater mechanical and thermal stability and a greater resistance to solvents than, for example, LB films. In addition, it should be possible to produce new layer elements applied to supports in the form of fairly large areas.

SUMMARY OF THE INVENTION

The disadvantages mentioned are overcome by the one- or multi-layered layer elements according to the invention applied to supports. The layer elements according to the invention form a highly ordered structure which is obtained by physisorption with the formation of salts and in each of which a uniformly charged surface is present which is coated in the subsequent layer with organic molecules having the opposite charge from that of the previous layer.

The invention relates to layer elements applied to a support, comprising