RESEARCH OF THE GEL POLYMER ELECTROLYTES

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The latest development in the field of the aprotic electrolytes is presented by the gel electrolytes. They are very different from materials used ever before. The electrolytes of the 2nd generation (based on PEO) are solids, which contain polymer modified by an organic liquid as softening agent. On contrary, the newest electrolytes contain liquid aprotic electrolyte, which is immobolised by a cross-linked structure of the polymer. These materials are called sometimes the electrolytes of the 3rd generation.

These gel electrolytes are prepared by mixing of suitable polymer or monomer with polymerization agent and cross - linking substance with a ionic electrolyte in the suitable polar anhydrous solvent.

The main application fields for them are the electrochemical power sources, electrochemical supercapacitors and electrochromic elements. The latter is an electrochemical cell (or battery), one or both electrodes of which exhibit color change and the design if which is optimized to ensure good visibility of the color change. This way, those elements may be used in the display elements, the multisegment display devices and windows or mirrors with electrically controlled brightness. Main requirements on the electrolyte in the electrochromic element are the great optical transparency, a sufficient content of the ions and adhesion to the surface of the electrodes. These conditions are satisfied also in the case of PMMA gel electrolytes.

Another application field of the gel electrolytes are the solid-state electrochemical sensors. The point was to design an electrochemical sensor, which will detect the formation of the hydrogen fluoride in high-voltage equipments (switches etc.), which contain sulphur hexafluoride as gaseous insulator. This sensor should not contain aqueous or any other liquid electrolyte, because water vapor could cause the decomposition of SF_6 in the electric discharges.

The nature of the gel depends on the ratio of the three components mentioned above. Increasing content of the oligomer decreases the elasticity of the gel, till the shape of the so-called organic glass (transparent solid) can be prepared. The polymerization goes faster if more of the initiator (dibenzoyl peroxide) in the mixture is used. The addition of propylene carbonate or another anhydrous solvent increases the elasticity. To ensure complete long term elasticity, the amount of the propylene carbonate should not be less than 0,70 ml to total amount 2 g of other components.

The gel keeps its mechanical characteristics for months.(in the laboratory temperature on the air). It is sticky and it does not leave the prints on the glass or another materials. It stays elastic and transparent and sheets of necessary thickness can be manufactured from it.

After the polymerization the perchlorate loses its hygroscopic nature,the gel does not absorb the water from the air and after the dipping into the water does not react. It is possible to dry it with no change of the mechanic properties.

Gels are soluble in chloroform and in carbon tetrachloride; this property does not depend on the ratio of the components. Gels are insoluble in the methanol and ethanol.

The change of the properties in time including the change of conductivity is called ageing of the gels. The most expressive reason to the change of the conductivity is the imperfect polymerization during the preparation of the gel. The polymerization should be finished by a treatment at elevated temperature. Otherwise, the resistance of the gel can sway for a long time. The using of this method of the preparation supports stability of the material conductivity after 5 - 10 days from the preparation and the conductivity remains stable for several months.

The monomer and the solution of the salt in PC are transparent and the oligomer is dissolved in the gel with no remainder. Therefore, the gel electrolyte exhibits a great optical permeability. This is very important for the application in the technology of the electrochromic elements, where high optical transparency is demanded together with sufficiently high electric conductivity.

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