Effects of molecular structure on dielectric relaxation of substituted cellulose

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Motivation

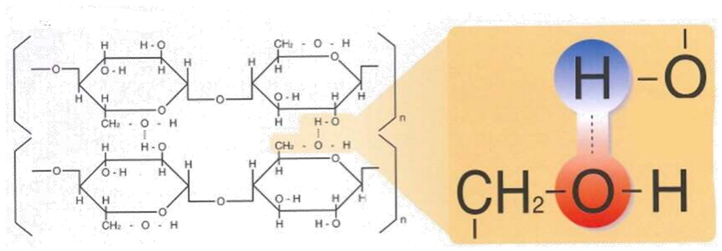
The rapid growth of the world's population leads to the growth of hazardous waste. New types of biologically based materials need to be developed to reduce waste and use hazardous chemicals. The use of biologically based materials is encouraged by a "green" policy that promotes environmentally friendly processes and recommends avoiding the use of hazardous chemicals. Among the various types of biologically based materials, cellulose is considered one of the most effective.

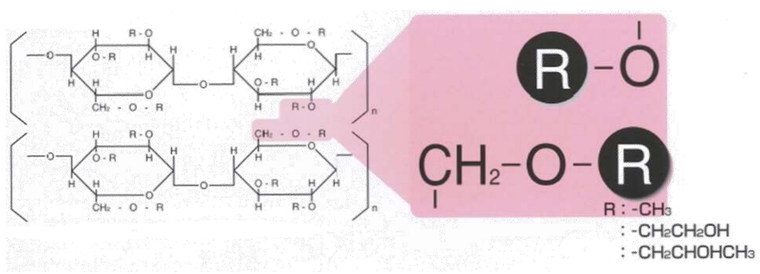
It can be made from cellulosic material of plant origin and some types of bacteria, called "bacterial cellulose". Cellulose is the basis of materials for various purposes. Therefore, the study of the properties of cellulose derivatives is relevant.

The aim of the study was to study the dielectric properties of hydroxypropylmethyl cellulose with varying degrees of substitution of hydroxyl groups by hydroxypropoxy groups.

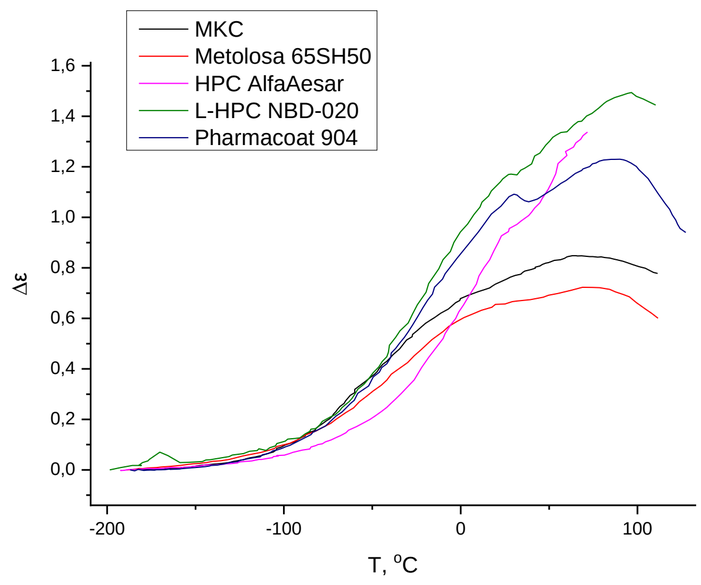
Samples of microcellulose

Here we present the results obtained for the microcrystalline cellulose produced by Chemfild Cellulose Pvt. Ltd. (0% substitution degree) and hydroxypropyl methylcellulose samples with different degrees of hydroxypropoxy group substitution: Metolosa 65SH50 ShinEtsu (6%), Pharmacoat 904 ShinEtsu (10%), L-HPC NBD-020 ShinEtsu (15%), HPC AlfaAesar (76%).

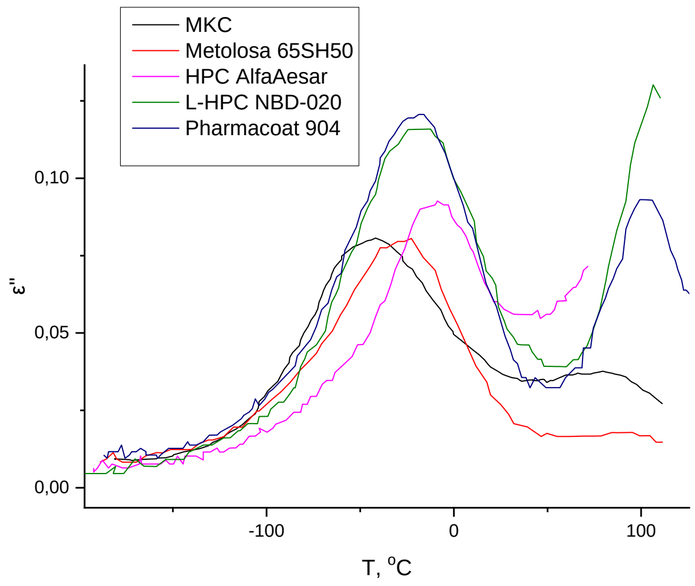




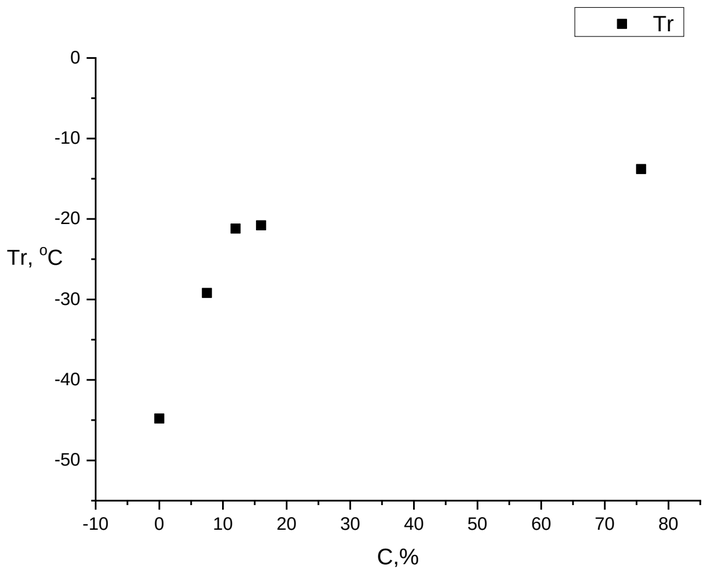
Dielectric spectroscopy



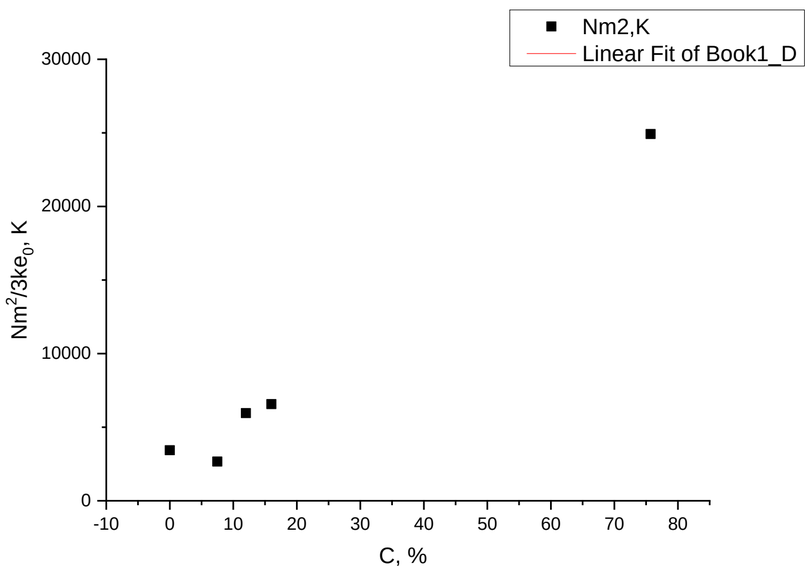
Temperature dependence of Δε at 10 kHz on the degree of substitution



Temperature dependence of ε '' per 10 kHz on the degree of substitution



Dependence of the temperature of the relaxation process at 10 kHz on the degree of substitution



Dependence of the change of the dipole moment during the relaxation process at 10 kHz on the degree of substitution

Conclusions

1. **In the process, the temperature dependences of the complex dielectric capacity at different frequencies for hydroxypropylmethyl celluloses with different concentrations of the hydroxypropoxy group were preserved.**
2. **It is shown that in hydroxypropylmethylcellulose there is a dielectric relaxation in the temperature range -120 ÷ 40 oC depending on whether it mixes at high temperature at increasing concentrations of hydroxypropoxy group.**
3. **It is established that the conformal motion of hydroxypropoxy groups includes the contribution to dielectric relaxation at high temperatures, as well as the conformational motion of methylol groups.**
4. **The method of dielectric spectroscopy at low temperatures can be used to assess the degree of substitution of OH groups for hydroxypropoxy groups in the structure of hydroxypropylmetal celluloses, which affect the pharmaceutical industry as new drugs and the rate of their review when applying to human services.**