Uniwersytet Wrocławski

Repozytorium

Plik pochodzi z repozytorium Wydziału Chemii Uniwersytetu Wrocławskiego

Development in dielectric relaxation of smectites due to intercalation of dimethyl sulfoxide and ethylene glycol

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Rok wydania

2025

Czasopismo

Journal of Molecular Structure

Numer woluminu

1321

Strony

139944/1-139944/7

DOI

10.1016/j.molstruc.2024.139944

Kolekcja

Naukowa

Język

Angielski

Typ publikacji

Artykuł

Streszczenie

Smectites are swelling layered minerals with the presence of counterions and water molecules in interlayer spaces. The movement of ions and dipole molecules located in the interlayer spaces leads to interesting dielectric properties. The systems are easily modifiable through intercalation. This paper is dedicated to examining the structural and electrical properties of hydrated nontronite, montmorillonite and their intercalates with DMSO and ethylene glycol. For this purpose, thermogravimetric, diffractometric, and dielectric measurements were performed. As a result of intercalation, the modified smectites showed a higher percentage of guest molecules compared to water in the unmodified minerals, leading to a larger interlayer distance for the modified systems. It turned out, that hydrated nontronite and montmorillonite exhibited different electrical properties due to variable water content. In the process of intercalation, the smectites regardless of the differences in the chemical composition of the layers and the type of counterions bound similar amounts of DMSO and ethylene glycol molecules. This resulted in similar relaxation times and dielectric increments for modifications, but different compared to the unmodified smectites. The activation energies of the relaxation process of modified minerals were reduced compared to the original minerals. The Maxwell–Wagner effect, and the relaxation of dipole guest molecules are responsible for most of the dielectric properties of the investigated materials.

Słowa kluczowe

Montmorillonite, Nontronite, Intercalates, Dielectric spectroscopy, Electric permittivity, Maxwell–Wagner effect, DMSO

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Adres publiczny

http://dx.doi.org/10.1016/j.molstruc.2024.139944

Strona internetowa wydawcy

http://www.elsevier.com

Plik został wygenerowany dnia 2026-11-04 06:31:00
Adres w repozytorium https://old.chem.uni.wroc.pl/pl/repozytorium/HaWf4Qy.