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Solubility Control of Inorganic Salts by the Cooperative Solvation of Polyethers

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Summary

The purpose of the present study is to control the solubility of a series of inorganic salts by the unique cooperative solvation force of polyethers.

Polyether can solubilize a lot of inorganic salts, but most of these solubilized salts were crystallized by heating. The phase separated crystals were revealed to be the same as that of initially added salts. This negative temperature dependence on the solubility was suggested to be governed by the entropic characteristics. Such phase separated salts were revealed to have larger lattice energy and larger cation radius. There is a certain chain length for cooperative interaction, and that was depended on the cation radius. This selective solvation of polyether was applied to separate the purposed salt from the mixture. As expected salts having larger lattice energy and larger cation radius were predominantly phase separated from the polyether solution. All these were confirmed by the X-ray diffraction analysis.

Polarity of polyether is quite large as polymers. This was easily comprehended by the large dipole moment of ether oxygens on the main chain. The polarity further increased by the addition of inorganic salts. The polarity, detected as the maximum wavelength of dye molecule, showed excellent relation with the lattice energy of the added salts. Further, the polarity was the function of both cation radius and lattice energy. From these, dissociation behavior of a series of inorganic salts in polyethers was confirmed. Also, the lattice energy of unknown salt was easily be able to be estimated by simply measuring the absorption maximum in PEO oligomers.

Salts containing divalent and trivalent cations were also solubilized in polyethers and their solubility was studied to collect the basic knowledge on the isolation and purification of a series of inorganic salts.