

## 広帯域誘電分光法による水複雑系の分子ダイナミクス

液体から固体における水とさまざまな物質の相互作用と協同運動性

### Dynamics in Aqueous Systems Studied by Broadband Dielectric Spectroscopy - Interaction and Cooperativity of Water and Various Materials from Liquid to Solid -

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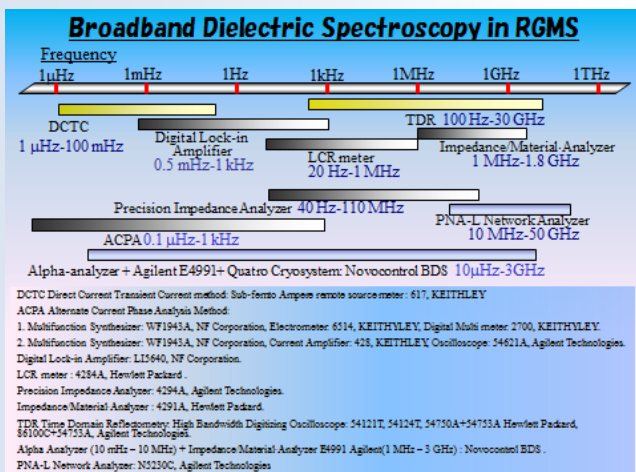


水を含んだ様々な物質の広帯域誘電分光 (BDS) 測定を  $1 \mu\text{Hz} \sim 50\text{GHz}$  の周波数域で行い、室温付近の液体状態から  $80\text{K}$  の低温のガラス状態で、溶質と水、さらにこれらの協同的な分子運動を誘電緩和として観測することができる。本研究の目的はアルコール、糖、合成高分子、タンパク質などの様々な水溶液で水や溶質分子運動の普遍的な特徴と物質構造依存性を解明することが本研究の目的である。

タンパク質と水の分子運動の同時観測など、分子運動観測手法の中で最も広い時間領域の BDS の特性を生かした類の無い結果が得られている。また、水を含まない分子性液体や高分子などの単純な物質を用いて構築された分子運動に関する理論的知見を、生体高分子水溶液などのより複雑な系に拡張してきた。我々が得た新たな知見は、食品、生体、コンクリートなど、水を含むすべての物質で起こる様々な現象のメカニズムの解明に応用することができる。

Broadband dielectric spectroscopy (BDS) is the most powerful method for observation of the dynamics of molecules in an extremely wide time window between mega-seconds and pico-seconds that covers the dynamics of solids to liquids. The progress of understanding the dynamics of aqueous solutions of molecular liquids, polymers, and proteins from solid to liquid states have been achieved by using BDS. The strong relationship between relaxation processes originating from local motion of water molecules and cooperative motion of water and guest molecules have been found. The universalities of the dynamical hierarchy from fast and local motion of water molecules to slow and global cooperative motion of hydrated guest molecules are successfully explained. These findings are valid for understanding the properties of water in foods, bio tissues, artificial organs, and any other various materials including water.

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