

Preface

The relevance and applicability of ionic liquids to many disciplines, ranging from synthesis to biomass processing, passing through spectroscopy and other physical chemistry methods has already been comprehensively described in the book “Ionic Liquids” edited by B. Kirchner in 2009 from the same publisher of this volume [1] and in a few other general reviews [2–5].

In this work, we have decided to focus our attention to the description of the structural features of ionic liquids, and to the experimental and theoretical methods to investigate them. Most of the studies performed so far have demonstrated, in fact, that even slight changes in the microscopic structure can have large effects on the macroscopic properties. Consequently, a thorough knowledge of these issues may be of fundamental importance to design task-specific liquids having the desired technological properties.

The volume begins with a [Chap. 1](#) by L. Gontrani, P. Ballirano, F. Leonelli, and R. Caminiti that describes how X-Ray diffraction can be used to describe the structural correlations in liquids in general and in ILs in particular, comprising an exposition of the underlying theory. A detailed exposition of the peculiarities and advantages of the energy dispersive variant of X-Ray diffraction is reported; a worked example on water-IL mixtures and a paragraph on the application of powder ADXD technique to study phase transitions in ionic liquids close the chapter.

One of the most interesting features recently reported for ionic liquids that can be revealed by X-Ray and neutron diffraction (particularly at small angle), namely the presence of mesoscopic domains, is described in detail in the [Chap. 2](#) by O. Russina, B. Fazio, G. Di Marco, R. Caminiti, and A. Triolo, which also presents some results of infrared and Raman studies. The potentialities of Raman spectroscopy to study ionic liquids are explored in [Chap. 3](#) by S. Mangialardo, L. Baldassarre, E. Bodo, and P. Postorino, who also dedicate some paragraphs to the role of PILs in protein refolding. [Chapter 4](#) by F. Mocci, A. Laaksonen, Y.-L. Wang, G. Saba, A. Lai, and F. Cesare Marincola is focused on the role that Nuclear Magnetic Resonance has in the field of Ionic Liquids structure, and discusses the contributions of this technique, that with its many variants is capable of unraveling both short and long range spatial correlations, as well as some dynamical aspects (like diffusion-related quantities). While the use of computational methods to interpret the experimental patterns is hinted at practically in all

chapters, only in [Chap. 5](#) (by E. Bodo and V. Migliorati) the issue is discussed more systematically with plenty of details. Back to X-Rays, [Chap. 6](#) by A. Zitolo and P. D'Angelo describes how the absorption spectroscopy (EXAFS and XANES) can yield very detailed pictures of the short-range local structure surrounding the ions that contain a XAS probe (e.g., hydrogen bonding in bromide ILs, or metal solutions). Finally, in [Chap. 7](#) S. Porcedda, M. Usula, and B. Marongiu give an overview of the volumetric and calorimetric properties of pure ILs and of their mixtures with molecular solvents.

As Editors of the volume, we hope that this collection of articles, all sharing the common leitmotif of “structure”, will give readers a complete picture of how different techniques tackle the same global issue and of which specific subtleties they can reveal, so as to help them choose the best approaches to design ever better performing ionic liquids. We are indebted to all the contributing authors for accomplishing such a demanding task.

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