

This article was downloaded by: [Tomsk State University of Control Systems and Radio]

On: 21 February 2013, At: 11:16

Publisher: Taylor & Francis

Informa Ltd Registered in England and Wales Registered Number: 1072954

Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/gmcl16>

Ionic and Electronic Conductivity in Coumarin and Benzophenone Complexes With Alkali Polyiodides

C. Wu^a, B. Kim^a, H. I. Kao^a, C. W. Griffin^a, M. Jones^a & M. M. Labes^a

^a Department of Chemistry, Temple University, Philadelphia, PA, 19122, USA

Version of record first published: 17 Oct 2011.

To cite this article: C. Wu, B. Kim, H. I. Kao, C. W. Griffin, M. Jones & M. M. Labes (1983): Ionic and Electronic Conductivity in Coumarin and Benzophenone Complexes With Alkali Polyiodides, *Molecular Crystals and Liquid Crystals*, 93:1, 381-383

To link to this article: <http://dx.doi.org/10.1080/00268948308073541>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.tandfonline.com/page/terms-and-conditions>

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae, and drug doses should be

independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

IONIC AND ELECTRONIC CONDUCTIVITY IN COUMARIN AND BENZOPHENONE COMPLEXES WITH ALKALI POLYIODIDES*

C. Wu, B. Kim, H. I. Kao, C. W. Griffin, M. Jones and M. M. Labes

Department of Chemistry, Temple University, Philadelphia, PA 19122, USA

A group of clathrated metal polyiodides has been prepared using the carbonyl compounds benzophenone, some of its derivatives, or coumarin as the organic "host" and alkali or ammonium iodide-iodine mixture as the "guest". We first reported¹ on the conductivity and optical properties of single crystals of (benzophenone)₉(KI)₂I₇CHCl₃, which have a golden, metallic reflection on the crystal surface parallel to the polyiodine chain axis. DC conductivity was $\sim 10^{-6} \Omega^{-1} \text{cm}^{-1}$ at room temperature, along this axis, and about one order of magnitude lower across the needle axis, whereas the (contactless) microwave conductivity was $\sim 10 \Omega^{-1} \text{cm}^{-1}$ at room temperature. The cation M⁺ was then varied to be Li⁺, Na⁺, Rb⁺, Cs⁺, NH₄⁺ and R₄N⁺, solvent of crystallization was varied, and it became clear that the conductivity was a mixture of ionic and electronic conductivity, the total varying from 10⁻² to 10⁻⁶ $\Omega^{-1} \text{cm}^{-1}$ depending on both cation and solvent.^{2,3} Structural work has indicated that, in most members of this series, the benzophenone forms a column in which the cation is six coordinate and the iodine columns are linear.⁴ However, when the cation is Li⁺, it is tetrahedrally coordinated to four oxygens of four benzophenone molecules. The columns of iodine are made up of I₅⁻ anions each of which is bent at the central iodine atom.⁵ Raman spectro-

scopic data confirm aspects of the iodine chain structure in these complexes.⁶

In this paper, details of the conductivity behavior of these benzophenone complexes are presented, together with an investigation of a family of more stable, more conductive complexes of coumarin with alkali iodides-iodine. All ac conductivity measurements were made along the needle axis of single crystals. For example, the ac (1 KHz) conductivity of the complex (coumarin)₄RbI₄ is $\sim .04 \Omega^{-1} \text{cm}^{-1}$. Data are also presented on a group of measurements attempting to distinguish between ionic and electronic processes in these crystals. Because of similarities in the optical and electrical behavior of all these complexes, a common transport mechanism, associating the conductivities with the iodine sub-lattices exclusively, is advanced.

In general, the coumarin complexes have higher conductivities than the benzophenone complexes. Their stoichiometry is in the approximate ratio coumarin:alkali ion:iodine = 4:1:4 to 5. Crystal structures are not known as of this writing. Both series of complexes clearly have an ionic component to their conductivity as indicated by their dc behavior, Faradaic experiments, and their abilities to function as electrodes for alkali batteries.

This work was supported by the National Science Foundation under Grant DMR79-05979.

* This work has been published in *Mol. Cryst. Liq. Cryst.* **88**, 317-330 (1982).

References:

1. M. M. Labes, M. Jones, H. I. Kao, L. Nichols, C. Hsu and T. O. Poehler, *Mol. Cryst. Liq. Cryst.* 52, 115 (1979).
2. M. M. Labes, H. I. Kao and M. Jones, American Chemical Society, Division of Organic Chemistry, Wurster Centennial Symposium, Washington, D. C., September 9-14 (1979).
3. H. I. Kao, Ph.D Dissertation, Temple University, October 1978.
4. P. Leung, P. van Tilborg and P. Coppens, American Crystallographic Assoc., Winter Meeting (1979).
5. P. Leung, R. F. Boehme and P. Coppens, *Mol. Cryst. Liq. Cryst.* 78, 319 (1981).
6. B. Bolton and P. N. Prasad, *Mol. Cryst. Liq. Cryst.* 76, 309 (1981).