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From the Editor's Desk

Pilgrimage of Phthalocyanine Macromolecule

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Phthalocyanine on Fornts other than Colourants (Part-III)

Hither -to till about two decades back, phthalocyanine macromolecules have been used mainly in the form of pigments and some of their soluble derivatives as dyes with their invariably blue and green colors. Though, right from the incept of their appearance in 1930's, phthalocyanine macromolecule (PC's), acquired a tremendous growth because of their following properties: i. 18-memberedconjugated bond structure with 4 surrounding benzene entities make this molecule extra stable chemically (non-vulnerable), ii. Pigment or dyes in this series are highly bright coloured compounds. iii. Resistant to heat (sublimation point 550ºC <), iv. Resistant to reduction, v. Resistant to Oxidation, vi. Resistant to Acids, vii. Resistant to alkalies, viii. Resistant to Light, ix. Resistant to other wear and tear, x. Large scale manufacturing possibilities.

These properties of the PC molecule attracted number of manufacturers and users for this class of compounds, so much so that they covered almost 60-70% of the total world production of colouredcompounds.Then, recently started an era of their (PC molecule) use in various fields other than colorants. An outline of their uses is given below-

Industrial importance of Phthalocynines (PC's)

PC's have unique properties such as semi-conductivity, electro-conductivity ,photo conductivity and non linear optics have been widely studied for both fundamental sciences and applications as optomagnetically recording materials. PC's have been synthesized for use as possible Lanmuir- Blogett films. PC's, particularly their discotic liquids – crystalline derivatives have attracted attention for use in photo voltaic cells. Their conjugated electron system make them very effective absorbers in the lower energy visible light region which is reflected in numerous applications in the field of opto-electronic devices. Interest in the homogenous and heterogeneous chemistry of Pc molecular crystals has a good growing interest. PC's are found to be most useful in their soluble forms and hence have been prepared in such a manner.

They arre used as sensors in conducting polymers, batteries and liquid crystals. Although the special nature of PC's and Mpc's has been known for decades, their uses as commercial pigments (green and blue), dyes,catalysts, lubricants, optical and electrical materials are expending enormously every year. Unsubstituted and substituted PC's are prepared and used as agents in photodynamic therapy of cancer.

The utility of Pc species in these many applications arises primarily from their specific versatile properties mentioned above. For most of the above applications, PC's bearing new specific ring substitutions have been prepared in order to improve their properties and utilities for above mentioned specific fields, as well as to enhance their solubility and decrease their melting points or allow coupling to other reagents like polymers.

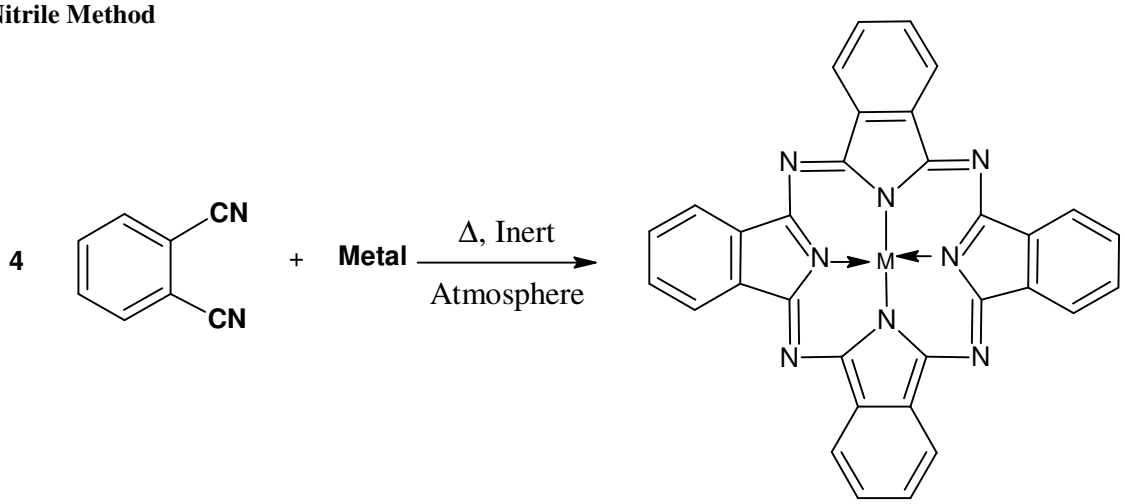
The rich coordination of Pc complexes has encouraged researchers to tailor specific products of specific properties for specific high technological utility. Introduction of great numbers of different metal ions into the Pc core and preparation of new axial substituents has created an infinite variety of noble products in the world of PC's .

The three main methods of laboratory/industrial preperations of these macromolecules have already been described in the previous accounts, and are also repeated below-

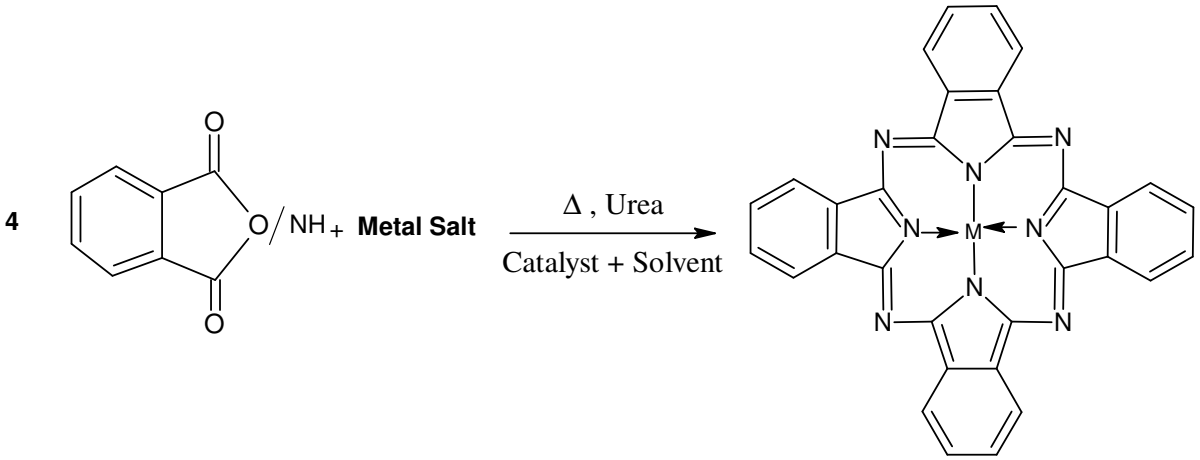
The Main Preparation routes in PC Series

In all these methods, 4 moles of slightly different phthalic acid derivatives are cyclised in different conditions to give a unsubstituted or substituted phthalocyanine molecules with 4 benzene entities substituted with different chemical groups specific end- issues

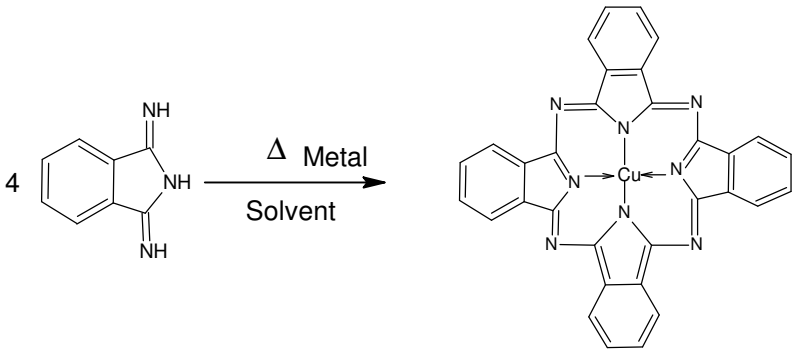
Nitrile Method



Wyler's Urea Method



Iso Indolin Method

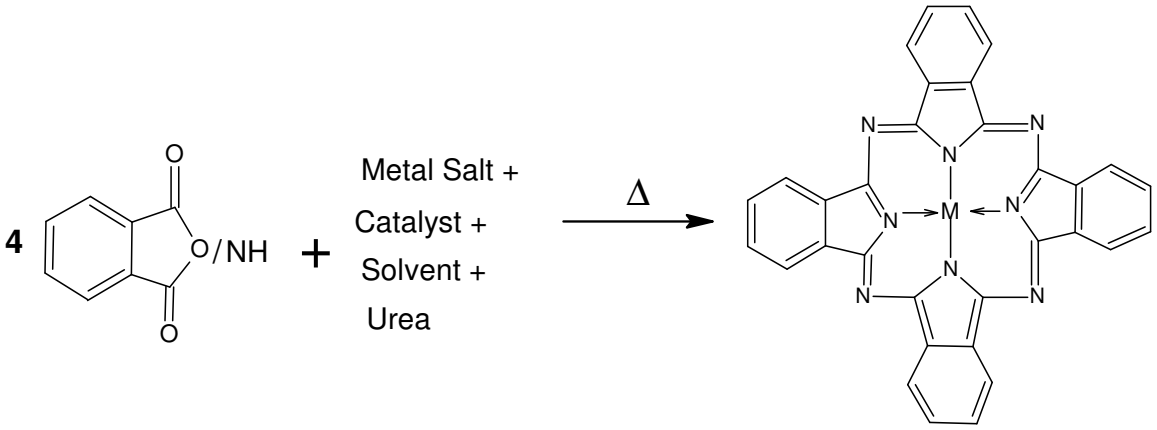


Cu PC

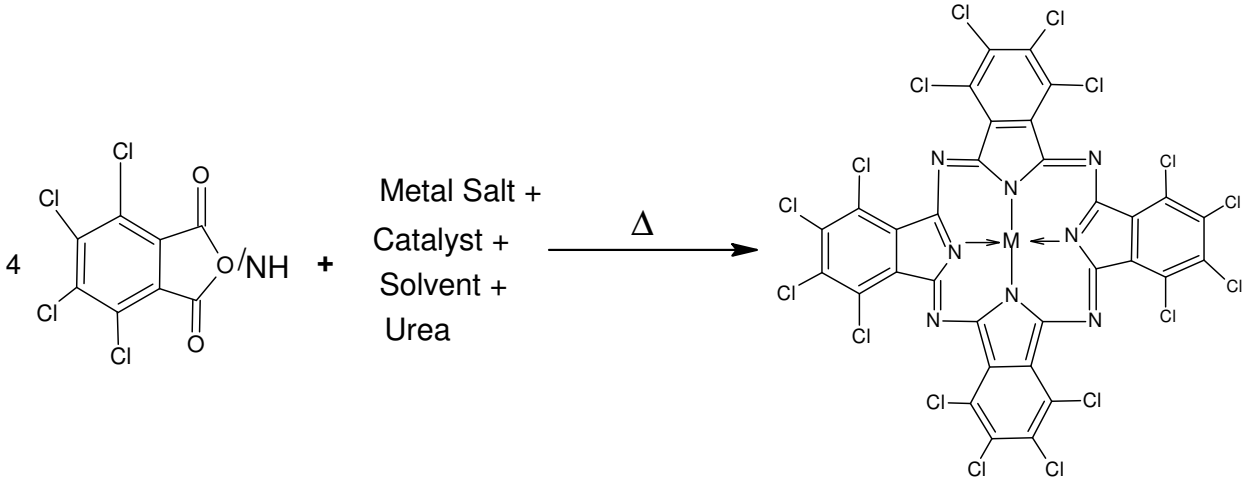
Some Important examples of PC derivatives used in some highly specialised fields

All these below 10 exemplified molecules for different specific uses have been prepared by tetracyclisation using 4 moles of different specific staring materials.

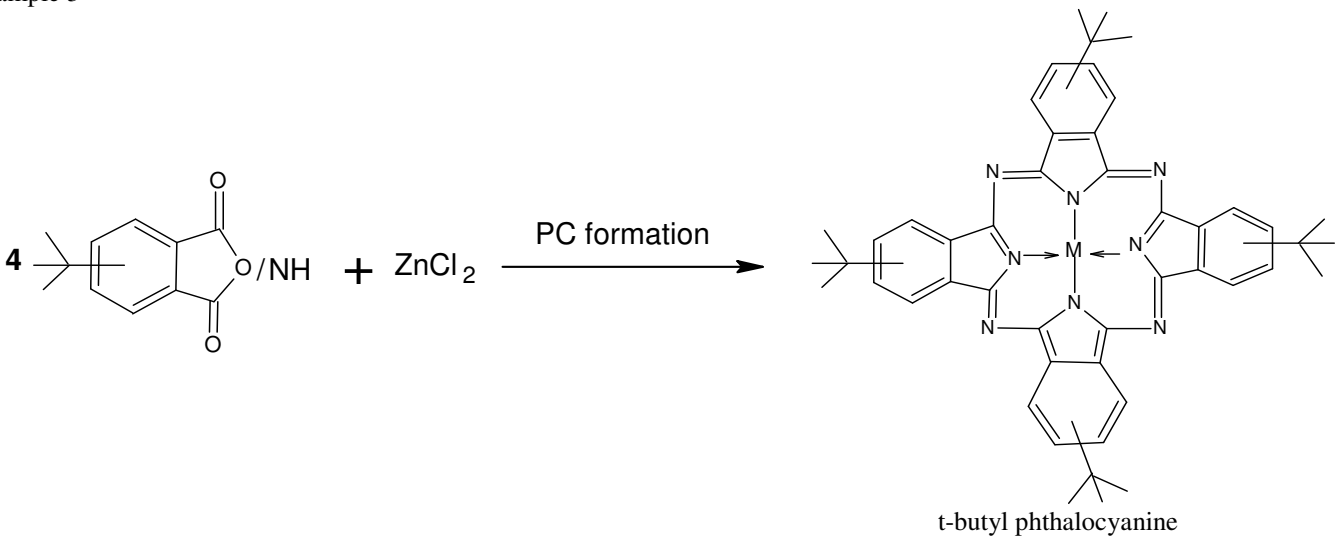
Example 1: Metal phthalocyanine used as a stable blue pigment, prepared and used in k-tonne quantities.



Example 2: Hexa deca chloro phthalocyanine, used as green stable pigment, Also prepared in large quantities

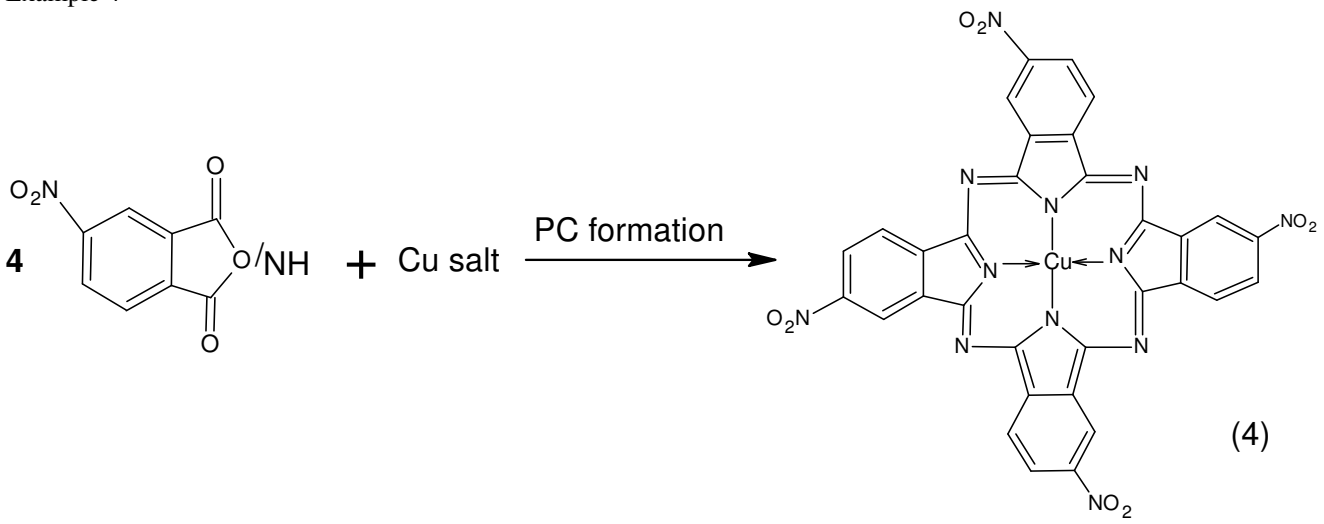


Example 3

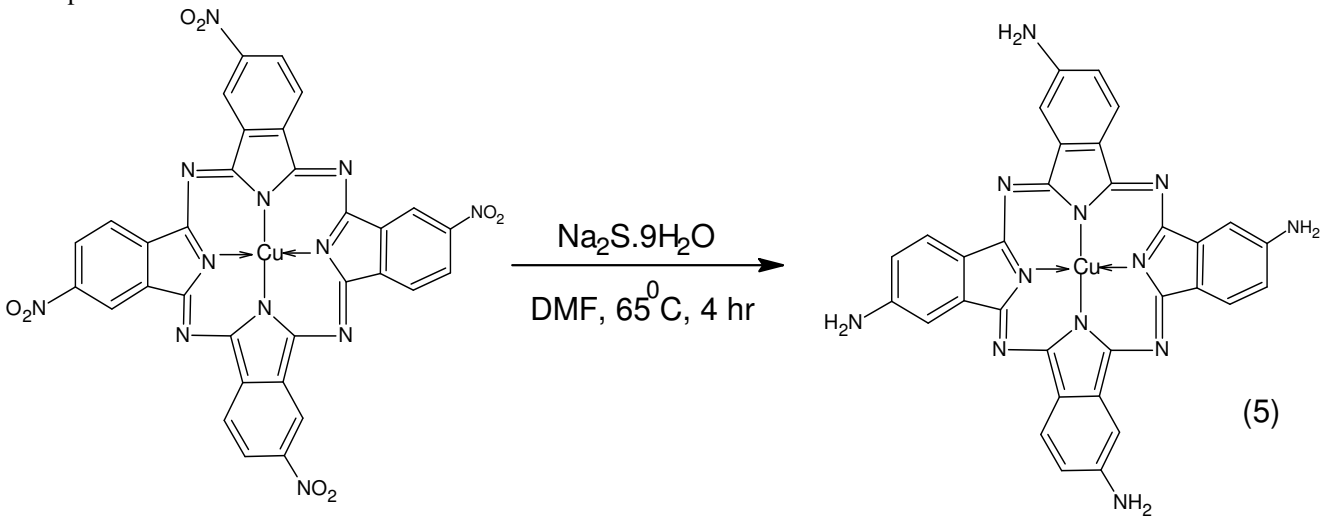


t-butyl phthalocyanine

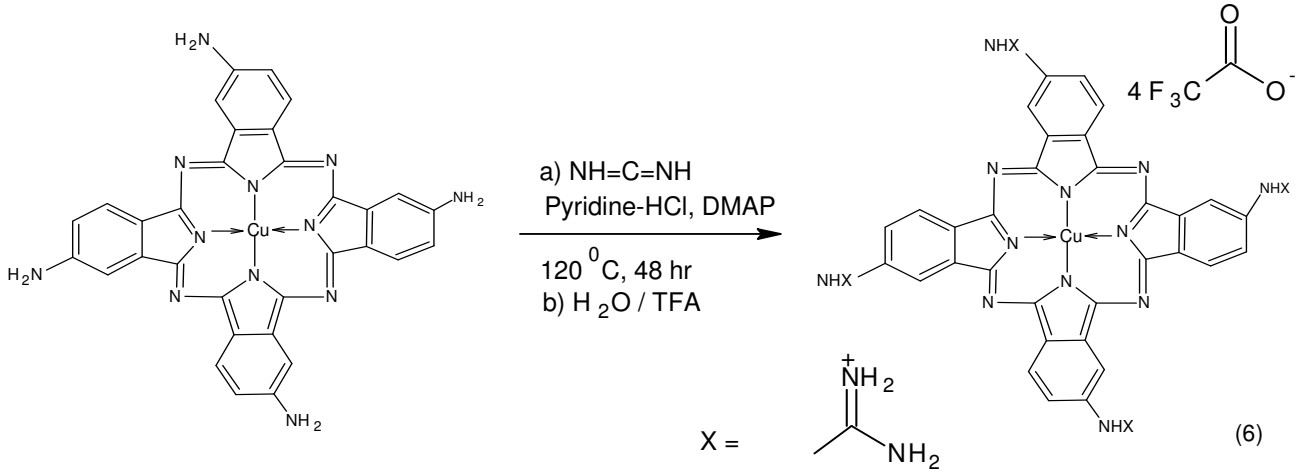
Example 4



Example 5



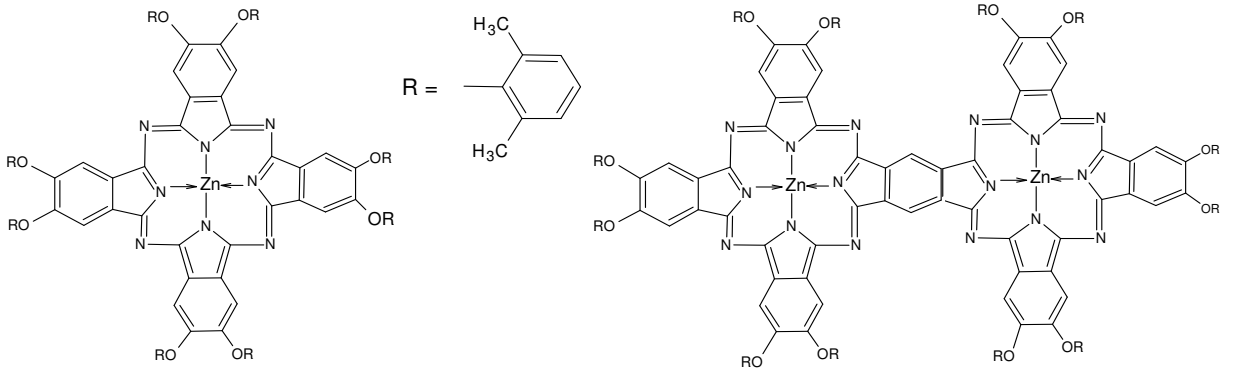
Example 6



Tetra amino copper phthalocyanine

Tetraguanidino-phthalocyanine[TFA.4salt]

Example 7



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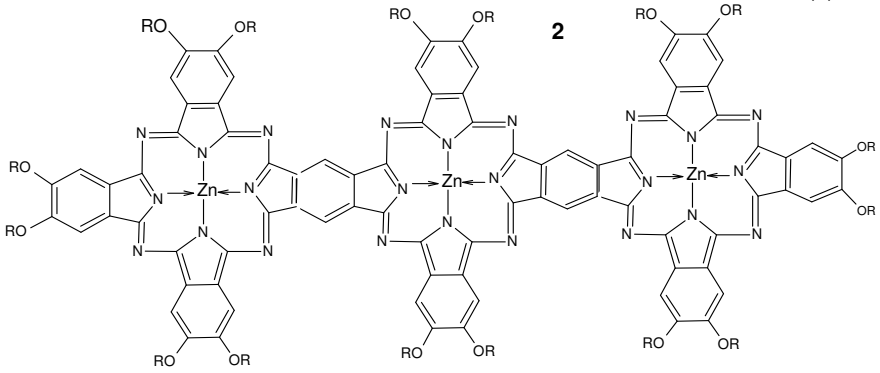
Formulae of the

- mononuclear phthalocyanine **1**
- dinuclear phthalocyanine **2**
- trinuclear phthalocyanine **3**



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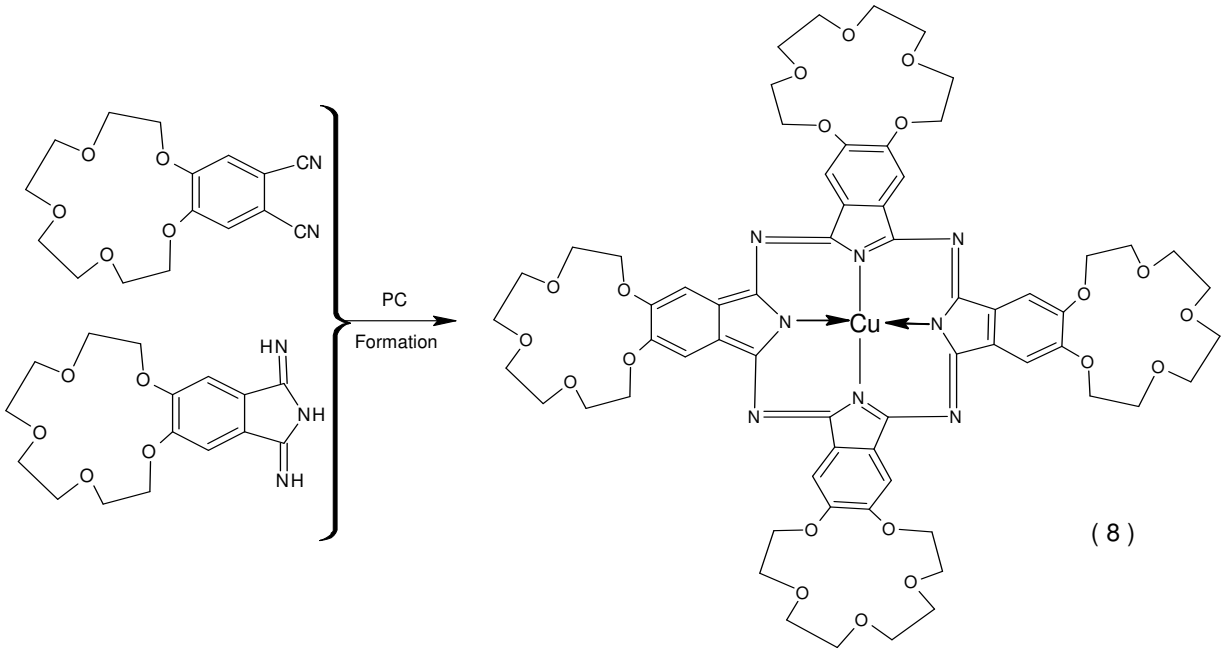
Potential applications- Organic solar cells

Example 8



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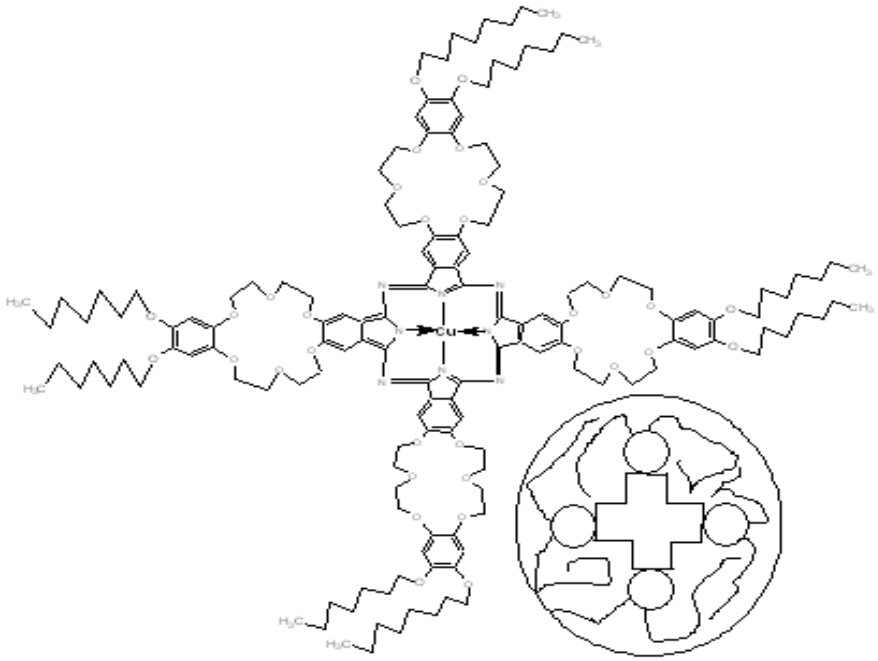
Crown ether substituted phthalocyanine

Example 9



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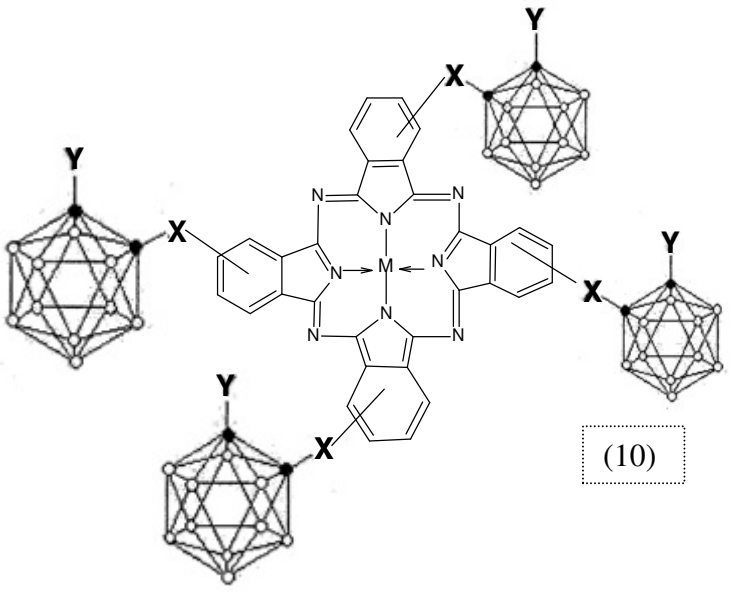
Long alkyl group crown ether substituted phthalocyanines. Also used as in the photovoltic cells

Example 10



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A group of scientists, Dr. Anjani Fadnis, Dr. N.C. Jain and Dr. Dipak Sharma of chemical laboratories of Maharaja Ranjit Singh College of Professional Sciences., Indore, INDIA, working on a research project 'Modification and Polymerisation of Phthalocyanine Macromolecule' funded by MPCST, Bhopal, MP, India has recently introduced a very simple new modification for the entry in the preparation of phthalocyanine series. Because of his intuitive and continuous hard work by Dr. N.C. Jain of the above group, this new method has been named as 'Nemi's Half Salt Method' of preparation of phthalocyanine macromolecules to be described in the next part (Part-IV) of this short article '**PILGRIMAGE OF PHTHALOCYANINE MACROMOLECULE'.**

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