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1,2-Dichloroethane 내 백금 전극에서의 dicarboximide 레이저 염료에 대한 convolutive 순환 전압-전류법 연구

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Convolutive Cyclic Voltammetry Investigation of Dicarboximide Laser Dye at a Platinum Electrode in 1,2-Dichloroethane

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요 약. N,N-bis(2,5-di-tert-butylphenyl) - 3,4,9,10 perylenebis(dicarboximide) 레이저 염료에 대한 전기화학적 연구가 0.1 M tetrabutyl ammonium perchlorate(TBAP)/1,2 dichloroethane(CH_2Cl-CH_2Cl)) 용액내에서 백금 전극을 이용하여 순환 전압-전류법 및 디지털 시뮬레이션 기술과 결합된 convolution-deconvolution 전압-전류법으로 수행되었다. 연구에 사용된 염료는 두 개의 전자를 순차적으로 소모하며 radiacal anion과 dianion으로(EE 메커니즘) 환원되었다. 전위를 positive scan으로 전환하면, 이 화합물은 두 개의 전자를 잃고 산화된 뒤 빠른 응집 과정(EC_1EC_2 메커니즘)을 거치게 된다. 이 화합물의 전극 반응 경로, 화학 및 전기화학적 파라미터는 순환 전압-전류법과 convolutive 전압-전류법을 이용하여 측정되었다. 이렇게 구한 전기화학적 파라미터는 디지털 시뮬레이션 방법을 통하여 검증되었다.

주제어: 태양 전지, 전류-전압법, convolutive 전류-전압법, 디지털 시뮬레이션, 전기화학적 파라미터

ABSTRACT. The electrochemical investigation of N,N-bis (2,5-di-tert-butylphenyl)-3,4,9,10 perylenebis (dicarboximide) laser dye have been carried out using cyclic voltammetry and convolution - deconvolution voltammetry combined with digital simulation technique at a platinum electrode in 0.1 mol/L tetrabutyl ammonium perchlorate (TBAP) in solvent 1,2 dichloroethane (CH_2Cl-CH_2Cl). The investigated dye was reduced via consumption of two sequential electrons to form radical anion and dianion (EE mechanism). In switching the potential to positive scan, the compound was oxidized by loss of two electrons, which were followed by a fast aggregation process (EC_1EC_2 mechanism). The electrode reaction pathway and the chemical and electrochemical parameters of the investigated compound were determined using cyclic voltammetry and convolutive voltammetry. The extracted electrochemical parameters were verified and confirmed via digital simulation method.
Keywords: Solar cells, cyclic voltammetry, convolutive voltammetry, digital simulation, electrochemical parameters

INTRODUCTION

The bis(2,5-di-tert-butylphenyl) imide(DBPI) of 3,4,9,10-perylenetetracarboxylic dianhydride is a member of a class of vat dyes that intrinsically are strongly colored and have high fluorescence quantum yield.[1,2] These properties make dyes such as DBPI potentially useful as photo sensitizers in energy and electron transfer reaction[3,4] and in site-selective spectroscopy experiments with biological systems.[5,6] Applications of perylene diimides as laser dyes and in p-n heterojunction solar cells have already been demonstrated by Bird and co-workers.[7]

In order to evaluate the potential usefulness of dyes such as DBPI as photosensitizer, it is necessary to determine their photophysical properties and redox potentials. The bulky tert - butyl groups on DBPI dye make this dye relatively soluble in a number of organic solvents.[8] DBPI dye was first prepared and studied by Rudemacher *et al.*[9] and its large scale synthesis was more described by Langhals.[10] The commercial product was probably a mixture