

表面与界面工程

靛蓝磺化物还原隐色和氧化脱色的薄层光谱电化学研究

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摘要

自制长光程薄层电化学池, 对靛蓝磺化物 (IC) 的还原隐色和氧化脱色过程及其逆过程进行循环伏安和双电势阶跃UV-Vis光谱电化学测量。结果表明, IC在不至过低的电势下 ($> -1.0 \text{ V vs Ag/AgCl/饱和KCl}$), 可通过 $2e^-/2H^+$ 可逆反应还原为隐色体, 其逆向电氧化过程的速率常数大于电还原速率常数1个数量级以上; 隐色体也可被溶解氧化学氧化, 导致电还原效率降低。在IC的电氧化脱色方面, 提出一种复杂的电化学-化学-电化学机理, 氧化生成的中间体通过水解发生中心C=C双键的断裂而转化为靛红磺酸, 后者在 1.0 V 以上的较高电势下进一步被不可逆电氧化降解为一系列小分子。

关键词

[光谱电化学](#) [靛蓝磺化物](#) [脱色](#) [紫外可见光谱](#) [氧化还原](#)

分类号

Thin-layer spectroelectrochemical study on reductive color-hiding and oxidative decolorization of indigo sulfonate

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Abstract

Thin-layer cyclic voltammetry and double potential step UV-Vis spectroelectrochemical method were used to study the reductive color-hiding and oxidative decolorization of indigo sulfonate (IC) in a long-path thin-layer electrochemical cell to understand the reaction mechanism in the two cases. IC was electro-reduced to its leuco form *via* a $2e^-/2H^+$ reversible reaction at appropriate potentials not lower than $-1.0 \text{ V (vs Ag/AgCl/saturated KCl)}$. The leuco-IC can be electrochemically reoxidized to IC with a rate constant an order of magnitude higher than that in the electro-reduction, or it can be chemically reoxidized by dissolved oxygen, leading to a decrease in electro-reduction efficiency. For the oxidative decolorization of IC, a complex electrochemical-chemical-electrochemical (ECE) mechanism was proposed, in which the oxidized intermediate formed in the first step decomposes to isatin sulfonic acid (ISA) upon cleavage of the center C=C double bond of IC, and the ISA may be further electro-degraded to small molecules at more positive potentials.

Key words

[spectroelectrochemistry](#) [indigo sulfonate](#) [decolorization](#) [in situ UV-Vis spectrum](#) [redox](#)

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